The Builder.

Vol. LVIII. No. 2460. Saturday, March 20, 1890.

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Design submitted by Mr. W. Campbell Jones (with two plans) ..... *Double-Page Photo-Litho.*
Design submitted by Mr. John Robinson (with two plans) ..... *Double-Page Photo-Litho.*
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Yorkshire Stone: Halifax District.

HALIFAX is surrounded on all sides by stone quarries; the hills bristle with cranes. Mount Tabor, Ringby, Northowram, Hipperholme, Lightcliffe, Brighouse, Southowram, Rastrick, Elland, Barkisland, form almost a complete circle around it. Sandstone of various colours and degrees of hardness, flaggy, fissile, and massive, abounds. To enumerate the quarries and quarry-owners within four miles of Halifax would prove quite a formidable task. In that part of the West Riding of Yorkshire which is known as "The Clothing District," there are more than four hundred quarry-owners and stone-merchants. In many cases the proprietor is a man of little capital, a workman himself, finding employment for perhaps half-a-score of fellow-workers. It is a large firm that holds three quarries. It would be almost impossible to describe the produce of every quarry; it would certainly be unprofitable, for many of them are worked out in a very few years, being of so limited an extent. Their small size is due in part, as before stated, to the small capital of their owners, which prevents them acquiring larger tracts of ground, and also in part to the risk that attaches to every purchase of land, inasmuch as the stone in it may prove almost worthless. Fifty yards may make all the difference between valuable and worthless in the bed of stone. The difference is not one so much of weight, or hardness, or durability, as of lamination and uniformity of colour. Each group of quarries has, however, certain characteristics more or less common to every one of that group, and, in a slight degree, differentiating it from the remaining quarries of the neighbourhood. It may, therefore, be of use to note the several groups, the mode of working them, the nature of their stones, and so forth.

It will perhaps be best, in the first place, to answer briefly the question, "What is 'Yorkshire stone'?" It is, of course, a sandstone, and, as Professor Page says, "*Sandstone* is simply consolidated sand, the particles having been compacted by pressure, or cemented together by lime, clay, iron-oxide, or other material." Sand consists chiefly of quartz grains, practically imperishable; it is therefore the matrix in which these are imbedded upon which the durability of the stone depends. The matrix of "Yorkshire stone" contains little or no lime; and consequently it is, says Professor Hull, "admirably adapted for resisting smoky atmospheres." That the stone does weather well in smoky atmospheres any one can see who looks at the buildings of Bradford, Halifax, Huddersfield, and neighbouring towns; only a few days ago we visited Manchester Townhall, built of Spinkwell stone (Bradford), and found that the mouldings and carvings and plain surfaces, though black with soot, were practically as perfect as on the day they left the mason's hands, twenty years ago. How different is the present appearance of this noble building from that of the once-beautiful church at Haley Hill, Halifax. The latter, designed by Sir George Gilbert Scott, was built of some kind of limestone (from what quarry we do not know), and has for several years been covered with white patches, showing where the stone is rapidly crumbling away. So great was its decay that last autumn an advertisement appeared in certain Yorkshire papers asking for contributions towards a fund "for its permanent repair," and towards a bazaar "for its immediate restoration, which is sadly needed." This is somewhat of a digression, but it is a peg whereon to hang a very important maxim—it is wise to ascertain the nature of the materials which a certain locality supplies, before introducing into it from another district a material the conduct of which, under such a change of circumstances, is, to say the least, exceedingly difficult to predicate.

It is not, however, of freestone like the Spinkwell of which we wish to treat at present, but of the laminated stone which, too hard for ornamental purposes, is so extensively used for flags, landings, and wall-stones. This stone is got from the lower beds of the Upper or True Coal Measures, which rest on the Millstone Grit, and form the highest group of rocks in the Carboniferous System. This system, which is of the Palæozoic or Primary period, lies immediately above the Old Red Sandstone or Devonian System (quarried chiefly in the far north-east of Scotland and south-west of England), and below the Permian (New Red Sandstone) System, which is quarried principally in the counties adjoining North Wales, in North-east Yorkshire, and on either side of the head of Solway Firth. The principal quarries of "Yorkshire stone" form a rough semicircle from Leeds, by Bradford and Halifax, to Huddersfield, and if the chord of this arc be drawn, the segment will enclose the chief iron-mines of Yorkshire (Lowmoor, Bowling, Kirkstall, and Farnley), and a considerable number of valuable coal-pits. The Halifax stone-district is terminated towards the east by a great "throw" or fault, extending in a direction south-east by south from Coley by Lightcliffe to Brighouse. A shaft was sunk some time ago near Lightcliffe, and from this headings were driven east and west. From the latter valuable stone was obtained; from the former nothing but shale, rag, and thin seams of coal. The dip of the strata throughout the district is to the south of south-east, or, as the quarrymen pictorially express it, "towards the ten o'clock sun," the strata being thrown off from the anticlinal axis of the Pennine chain.

Of the quarries, or rather groups of quarries, in the vicinity of Halifax, writers have, we believe, seldom or never mentioned more than four. Comparatively little has been added to our knowledge of building stones since the Report of the Royal Commission on the Selection of Stone for Building the new Houses of Parliament was published, fifty years ago. Subsequent writers have used this as a rich mine, from which they could gather information at will. It is Gwilt's gospel. To say the least, however, this report, while still true in the main, perhaps, requires considerable additions to bring it up to date. Of Halifax quarries, Gwilt,* Professor Hull,† and Mr. John Slater, B.A.,‡ mention only Elland Edge; in the series of articles on "Stone Quarries" which appeared in the *Builder* in 1886, we named the North and South Owram Quarries; and Rivington's "Notes on Building Construction" (Part III.) includes Ringby in addition to the foregoing. But the demand for "Yorkshire stone" has increased so much during the last quarter of a century that numerous other groups of quarries have been opened or extended, notably at Hipperholme, Lightcliffe, Brighouse, and Rastrick; also at Barkisland, Greetland, Thornton, &c.

A few words may with advantage be said of the manner of quarrying the stone, which varies at different places. For whereas at Lightcliffe the whole of the quarries are opened out, at Brighouse nearly all are stone-

* Encyclopædia of Architecture

† "On Building and Ornamental Stones."

‡ Paper on "Building Stones," read before the London Architectural Association in March, 1885.

mines. The mode of working adopted depends chiefly upon the depth at which the valuable beds are situated; to open out a quarry at Brighouse, where the stone lies about forty yards below the surface, is an undertaking seldom attempted, but at Lightcliffe a good bed of stone is found at a depth of little more than a dozen yards, and here open working is adopted. Southowram and Northowram are at elevations considerably greater than the places just mentioned, but the stone, on account of the inclination of the stratum, is not as far from the surface as at Brighouse; consequently nearly all are open quarries, the exceptions being three shafts at Park, Northowram, belonging to Messrs. J. Brooke & Sons. There is no doubt that open working is—considered apart from the first cost of clearing the ground—considerably more economical, and it has this further advantage, that blocks of stone for landings may be obtained of the largest size that the vertical seams in the rock will allow, whereas in mines the size of stone is limited by the diameter of the pit-shaft (usually 9 ft.): thus, at Roper's pit or mine at Brighouse we saw landings 12 ft. by 6 ft. 6 in., which are almost as large as can there be obtained, while at the open quarry belonging to Farrars, Limited, situate about a hundred yards from Roper's, landings have been got 16 ft. by 9 ft. 6 in, and others 10 ft. and 12 ft. square. It may be asked, "Why not enlarge the pit-shaft?" Messrs. Roper & Sons did begin to increase their shaft to 11 ft. in diameter, but desisted because it would not pay. Landings do not constitute the chief produce of their quarries, and therefore pit-owners are content to let rival traders supply stones of exceptional sizes, not considering it worth while to enter into competition with them.

It may here be stated that, as a rule, the open workings of the districts are huge pits in the earth, the stone being attacked from above,—not quarries on steep hill sides where the whole vertical face of the stone is exposed to view. There are, it is true, a considerable number of the latter kind within easy distance of Halifax, situate among the precipitous hills of the Pennine range, on the borders of Lancashire and Yorkshire, but the stone from these quarries is of the Millstone Grit formation, and of a coarser texture and more massive structure than the "Yorkshire stone" of which we are speaking. It may not be out of place to say that this coarse sandstone (known in the immediate vicinity as "native sandstone" or "coarse grit," in contradistinction to the "Yorkshire stone," which is known as "fine grit") is used for heavy works, such as engine-beds, &c., and in bygone years was extensively used for building purposes; but the smaller cost of "flat-bedded" wallstones from the neighbourhood of Halifax, and the increased facilities of transporting them by boat and rail, have almost stopped its use. The stone, however, weathers excellently, as the numerous many-mullioned farm-houses, chiefly built in the peaceful years that opened the seventeenth century, testify to all who care to wander over the hills near Todmorden and Hebden Bridge.

To return to our Yorkshire quarries: we will take one special one, which is a fair type of its class. Here we find the steam-cranes are perched on the very edge of the perpendicular face of the working. Their situation is precarious; now and then one goes headlong to the bottom,—very likely to the ruin of its owner. The section of the ground shows various strata and bands of more or less worthless material, and three beds of valuable stone. The band of "hard stone" near the surface is full of small dark streaks,—fossil-twigs, or rather their impressions,—and is of no use except for road-metal and for filling-up disused workings of neighbouring stone mines: the "rag" is sold for footings in various widths and thicknesses up to 4 or 5 ft. and 8 or 9 in. respectively,* but if there are no orders in hand for footings, the rag is thrown into a worked-out portion of the quarry as so much rubbish cumbering the ground above. The band of stone in thin layers supplies the commonest kind of flags, termed "shoddy flags;" the sound rag under the last is used for steps. After a course of rough rag, a bed of ashlar, 6 ft. thick, with planes of bedding practically invisible, is reached; this is used for paving-setts, as numerous marl-balls and patches of hard glittering spar render it unfit for larger and better work. The first bed of good rock, about 10 ft. thick, now follows, and this is separated from the second by about 2 ft. of rubbish. The second bed is 4 ft. thick, and 5 ft. below it is the third or bottom bed, 11 ft. in thickness. The stone from the bottom bed is the best in the quarry, close in texture, of uniform colour, sound, hard, and durable; it will also take a good polish. The stone from the top and middle beds cleaves rather more readily than the last, and is, perhaps, not quite as close in texture, but the difference can only be perceived by a practised eye; however, there is a difference, sufficient to induce the owners to classify the two stones as of different qualities.

It will be seen from this description how various are the beds of stone which are worked in a single quarry, and the architect cannot but feel that, do what he may to select a good quarry, he is, after all, very much at the mercy of its owner. It is one thing to specify that all stone shall be from a certain bed; it is another thing to get what is specified. The carelessness of workmen, the apparent similarity of the stone from another bed,—apart from actual dishonesty—are quite enough to account for the presence of pieces of inferior stone in any large consignment. These may not be detected at the time (it is impossible for the architect to examine every single stone that comes to a job, and clerks of works, too, are only mortal), but they will proclaim themselves in a few years by discolouration or decay, or, in the case of flags, by wearing off in flakes. For the difference of quality in one consignment, stone-merchants likewise are largely responsible, as stones from several quarries, having perhaps little in common with each other, are mixed together and sold indiscriminately; the result is usually more or less unsatisfactory.

We will now look at one of the Brighouse quarries or mines, and notice the mode of working usually adopted. A circular shaft, 9 ft. in diameter, is sunk through the gravel, shale, and rag, until the bed of good stone is reached at a depth varying from 38 to 42 yards. From the bottom of the shaft a heading is driven at right angles to the dip of the strata, that is to say, nearly north-east and south-west. The width of the heading is largely regulated by the vertical "bottoming seams" which occur in the bed of stone; five or six yards may be taken as an average width, and an increase of this is not desired, as it necessitates larger timbers for supporting the roof, and consequently additional expense. The height, of course, varies with the thickness of the bed, which in some quarries is about 5 ft., in others 20 ft. The heading, however, is always 2 or 3 ft. higher than the stratum of stone which is to be quarried, just enough, in fact, to permit the insertion of the roof-timbers before the underlying stone is removed. When the roof has been securely timbered for a few yards the stone-getting begins, and the valuable stone and all rubbish which would otherwise obstruct the work are carried to the surface. As soon as this

main heading has been driven to the limits of the ground belonging to the owner, cross-headings are commenced from one or both ends of it. In Mr. Cliffe's quarry the cross-headings are, for the sake of safety, in opposite directions. Each of these, when the stone has been exhausted to the full extent of the ground, is filled up with the waste material which had been taken to the surface, and also with large blocks of hard, rough stone from neighbouring open quarries. Some of these blocks may be had for the fetching, but for others the mine-owner must pay a shilling a load (frequently of one or two stones only), and be at the expense of carting them a distance, in some cases, of two or three miles. The roof-beams are usually removed as the filling proceeds, and when this work is completed back to the main gallery again another breadth of stone is attacked, the roof-timbers now resting at one end on the built-up gallery, and at the other on the solid rock. In this manner operations are carried on until very little stone indeed of any value is left in the pit; the shaft is filled up, and the ground left to settle. In a few years an adventurous person may perhaps utilise it as building land.

Sometimes both open-working and mining are adopted in the same quarry, as at Twait's at Southowram, where a heading is driven from the bottom of the open part under a hill which rises rapidly behind the quarry.

Let us now turn to the working of the stone after it has been brought to the surface of the ground. It is first necessary to state that the stone is divisible into two classes, which may be distinguished either as "thin lift" and "thick lift" stone, or as "self-bedded" and "riving" stone. The terms "thin-lift" and "self-bedded" are applied to that class of stone which is separated naturally by plates of mica into layers, varying in thickness from ⅛ in. to 7 in. or 8 in.; in fact the stone is that known by geologists as "flaggy." Each face of every layer is, in the language of the quarrymen, "black;" the colour when dry really varies from light grey to brown, and is powdered with glittering flakes of mica. Ripple-marks are frequently noticeable, rendering the surface of the stone uneven. The "thick-lift" or "riving" stone is more correctly known as "fissile;" it can be split with wedges in planes parallel to the planes of bedding, but does not exhibit plates of mica, the riven faces being "white." Every group of quarries supplies some stone of the "thin-lift" or "self-bedded" class; but not by any means in equal proportions to the "riving" stone. For instance, at Messrs. Cliffe's and other mines at Lane Head, Brighouse, the stone is obtained from a "thin-lift" bed about 3 ft. thick, and a "riving" bed about 4 ft. thick immediately above it. At Lightcliffe and Hipperholme, and also at Northowram, the stone consists almost entirely of riving rock. In the section of Messrs. J. Brooke & Sons' Yew Tree Quarry at Lightcliffe, the "thin-lift" band occurs about halfway down the quarry; it is little more than a foot thick, and from this and an occasional thin layer between two thick lifts of riving rock, they obtain a very limited quantity of self-bedded material. The three groups of quarries last mentioned are on the same hill within a short distance of each other. Southowram, like Brighouse, has beds of both classes. Rastrick and Elland Lower Edge have little but riving rock; in fact, at the latter place, the thin-lift band is only about a foot thick, whereas the remainder of the stone (which is here below the thin-lift band) is upwards of 30 ft. in thickness. At Elland Upper Edge some of the mines and quarries are similar to the last-named, while others supply self-bedded stone almost exclusively. This general statement of the class of stone obtained at each group of quarries must be borne in mind, as the nature and marketable form of the two classes vary.

The "self-bedded" stones, on reaching the surface, are roughly squared and sorted according to their quality and thickness. Those with rough, uneven surfaces, or much thinner at one end than the other, are sold as "rough shoddy flags," at prices varying from 1s. to

* It is not far from truth to say that no brick foundations are used in the neighbourhood of Halifax, nor is concrete common except in large buildings; the general method of forming foundations is by one or two courses of stone footings, the upper course being narrower than the lower.

1s. 6d. a yard.* Architects are only just beginning to learn that such a quality of stone is obtainable, but builders have known it long enough, and, very frequently, indeed, within our own knowledge, have taken advantage of the architect's ignorance by substituting shoddy flags for the self-faced flags specified; if the architect said that the surfaces were rough and so on, the builder had the reply pat, "Ah, well, Sir, you only specified self-faced flags, and that's what these are [so they are]; if you want a downright good job, you should have tooled flags, Sir." The builder's conscience, as a rule, however, permits him to lay shoddy flags in cellars only, where their defects are not so easily seen.

The stones with smooth mica faces and of fairly uniform thickness are sorted according to their thickness and sold as follows: ½-in. "thin grey slates," three-quarters to seven-eighths of an inch; "best grey slates," inch and inch-and-a-quarter; "thin shoddy flags," 1¼ in., 2 in., 2½ in., 3 in., and (sometimes) 4 in. "self-faced flags," and "self-faced landings," up to 7 in. and even 1 ft. thick. The slates are used chiefly in the immediate vicinity of the quarries, and are sold at about 30s. per "hundred" of 120 slates of various sizes, estimated to cover about 18 square yards when laid. "River slates" with "white" faces are supplied from many quarries; these are worth 10s. per "hundred" more than the self-faced ones, and are considered more durable, but a hundred will cover only about 16 yards. The jerry builders of Lancashire buy most of the "thin shoddy flags;" they are, of course, cheaper than the thicker "self-faced flags," and being lighter cost less in carriage; when laid, no one can see the thickness, so what does it matter to the jerry-builder? Two-inch self-faced flags are sold at 2s. 2d. per square yard; 2½ in. at 2s. 6d.; and 3 in. at 2s. 8d. The prices vary a little at the different quarries; landings, 30 ft. to 50 ft., 2d. per in. thick, 50 ft. to 90 ft., 2½d., above 90 ft., 3d., but seldom more than a 1d. or 2d. per yard. It is scarcely possible to give the price of landings, as it varies so much according to the size; but one rule in vogue among the quarry owners is to consider all landings containing more than about 50 square ft. to be worth per square ft. 2d. for 1 in. in thickness; thus, a large 5-in. landing would be worth 10d. a foot.

Of the sizes of landings we have already said a little in the previous article. At Roper's quarry, Lightcliffe-road, Brighouse, we saw self-faced landings measuring 12 ft. by 6 ft. 6 in., and only 2½ in. thick. Marshall & Walker, of Elland, Upper Edge, supplied a landing 16 ft. 6 in. by 5 ft. 9 in. by 8 in. for the balcony, at the Town Hall recently built at Elland; this landing when brought to the surface measured 18 ft. by 7 ft. 9 in., and as the shaft at the quarry is only 9 ft. in diameter, the difficultty involved in raising so large a stone must have been very great. The largest landing, as far as we know, which has been sent from the Halifax district, was obtained by Farrars, Limited, at their Granny Hall Quarry, Lightcliffe-road, Brighouse; it measured 16 ft. by 9 ft. 6 in., containing therefore 152 square feet, and was 10 in. thick. Doubtless landings of this size have been and can be obtained from other quarries, but we have no accurate information on the subject.

For self-bedded material generally, we may say that Brighouse, Southowram, and Elland Upper Edge are the best in the district, Southowram stone is chiefly put into trucks at Halifax Station; the other two groups send their stone from Brighouse Station.

The "thick-lift" or "riving" rock is brought to the surface in blocks up to a yard in thickness. It is then split by wedges along the lines of lamination: these are darker streaks, sometimes barely visible, sometimes well defined. It must not be considered, however, that the stone is easily cleft along these lines; rather, it must be understood that it *can* be split or riven in this direction, but with difficulty. The different layers, as split one after another from the block, do not present, as a rule, smooth level faces, and can therefore seldom be sold as "self-faced" material. Some of them are roughly dressed with a boasting chisel, the prominences being worked off and the flags (as it is termed) "taken out of twist." No regularity is attempted in this mode of working; the chisel-marks are at all angles with the sides of the flag, and occur merely where quite necessary. These flags are sold as "knotted" or "boasted" in various thicknesses: the 2½ in. ones being worth nearly 3s. a yard. They are extensively used for footpaths of streets, where strict economy is practised, and are as a rule durable, although certainly not of a prepossessing appearance. Some of the flags obtained from "riving rock," if varying much in thickness or otherwise unsuitable for boasting or tooling, are put into the class of "rough shoddy flags," previously described. By far the greatest quantity of the "thick-lift" stone, however, is carefully tooled with a chisel about 4 in. broad, and sold as "tooled flags." The usual thicknesses are 2½ in. and 3 in., but 3½ in. and 4 in. flags may be had to order. With the exception of those at Upper and Lower Elland Edge, all the quarries supply tooled flags. The prices vary a little, but 3s. 5d. per yard for 2½ in. flags may be taken as the general rate. Some quarry-owners ask a penny a yard more for 3 in. flags, but others are content to sell them at the same price as 2½ in. The reason they give for this is the extensive demand in London for 2½ in. flags on account of the saving in carriage, and consequently an enhancement of the price of 2½ in. and a depreciation of 3 in. Roughly speaking there are 5½ square yards of 3 in. flags to the ton, and 6½ of 2½ in., and as the rate of carriage from the district to London is 10s. 10d. a ton, the saving effected in carriage is rather more than 3½d. a yard.

A considerable number of "polished" flags are put into the market, but none whatever are supplied from the Elland Edges, Rastrick, or Brighouse. Messrs. Joseph Brooke & Sons, at their Yew Tree Quarry, Lightcliffe, polish selected stone from their quarries at Northowram, Hipperholme, and Lightcliffe (bottom bed), and classify it as their "Silex Brand." We have specimens from all the three quarries, and notice that all of them are so close in texture that the polished surface has a considerable sheen, after the nature of granite, but, of course, inferior to it. In addition to their own stone, Messrs. Brooke & Sons polish stone for other quarry-owners at Hipperholme and Lightcliffe. The method of polishing has a primitive appearance, and consists of a strong horizontal double beam, balanced at the middle on an upright shaft, which receives a rotary motion underground from an adjoining steam-engine. The beam is 30 ft. long, and a circular table of "knotted" flags (containing about 90 square yards) is carefully laid under it; to the beam itself about 40 additional yards of flags, steps, &c., are attached by a number of chains, and these flags, as the beam turns round on its central pivot, are dragged over the table below, until they are polished. Water is continually streaming on to the stones from a supply in the centre, and a man is employed to scatter sand over the table. The upper (moving) stones are sufficiently polished in twelve or thirteen hours; the lower are finished in about double the time.

Messrs. Charnock & Sons have a polishing-machine at Charlestown in Halifax, and here stone from Southowram is brought. Messrs. John Farrar & Sons polish their stone from Southowram at Brookfoot, and also polish their stone at Thornton; but as this is nearer Bradford than Halifax, it is beyond the province of this article. We may say, however, that the stone is of a blue-grey colour, very similar to Northowram stone, but perhaps a little coarser in texture. The polishing-machines just mentioned consist of a rotary circular table of flags, over which a rectangular table moves to-and-fro. They do not turn out as much work in a certain time as does the machine in use at Lightcliffe.

The price of 2½ in. polished flags is about 4s. per yard.

Landings, of course, may be had either tooled, polished, or boasted. It must be borne in mind, however, that the same remarks apply to these as to flags,—namely, that all quarries except those at the Elland Edges supply tooled flags, and that there are only three firms in the district who own polishing-machines.

A considerable number of landings are supplied for the construction of chemical cisterns in Widnes and other Lancashire towns. From Farrars' quarries at Brighouse stones 12 ft. square and 1 ft. thick, weighing about ten tons each, have been sent for this purpose. Stone is severely tested by chemical manufacturers before being adopted, and it may fairly be argued that whatever will resist the continued action of powerful chemicals will be able to withstand the same chemicals in the diluted form in which they are present in the atmosphere. Stone also from Northowram and Lightcliffe is used for chemical purposes. One of the tests to which the stone from Brookes's quarries has been subjected is submersion in hydrochloric acid, both cold and heated to 120 deg. Fahrenheit; it stood both tests perfectly, did not decompose or diminish in weight, and showed no trace of lime in its composition. The presence of iron was, however, detected,—more particularly in the bluer varieties.

Besides the material already mentioned, most of the quarries supply paving-sets, steps, and curbs for footpaths. Elland Lower Edge enjoys a great reputation for paving-sets; in fact, it is not far from the mark to say that the four quarries at this place and three of those at Upper Edge supply nothing but sets, curbs, and steps. Sheffield and other Corporations, and numerous Local Boards, have used this stone. Its weight, according to the report of the Commissioners for selecting stone for the Houses of Parliament, is 153¼ lbs. per cubic ft.; for purposes of comparison we may say that the Commissioners state the weight of Bath stone to be from 116 to 123 lbs. per ft., of Portland stone from 126¾ (roach) to 145½ (curf), of Craigleith stone about 145 lbs., and of granite about 166 lbs.—very nearly the same weight as the Kentish rag.

Steps are frequently delivered in a rough state, and worked on the building site itself. They may, however, be obtained either tooled or polished. Street-curbs are supplied self-faced and tooled. In addition to these some of the Brighouse and Lightcliffe quarries send a large quantity of platform coping to the various railway companies. These are all brought to uniform widths of 3 or 4 ft., are 3 or 4 in. in thickness, tooled, and bull-nosed along one edge.

We may say that flags for the best work are supplied of uniform widths, or as it is termed, of a certain "gauge," so that they can be laid in equal parallel rows.

In our issue of the 14th of September last year, we printed a letter from Sir Robert Rawlinson, loudly in praise of artificial stone, and equally loudly in condemnation of Yorkshire flagstones. Sir Robert's letter elicited two excellent replies from "Town Surveyor," but we now know that certain Yorkshiremen refrained from writing simply because they thought it was not worth while. The gist of Sir Robert's letter is in the following passage:—"I have . . . walked over the York-flagged foot-pavements in the West-end of London, and can only say that in wear they are true to the name flagstone—a stone which wears in flakes. *There is not a single square yard of foot pavement of Yorkshire flags which has been six months in wear which is not showing flakes.* The artificial Croft flags, on the contrary, will wear to the last, and be sound." Now, we do not pretend to have carefully examined every square yard of flags in the West-end of London, but we can certainly say that we entirely dissent from the

* All prices given in this article are for stone put in truck at the nearest railway station, and may be taken as the average prices current at the present time.

strong statement which we have printed in italics. It cannot be denied that a large number of the Yorkshire flags which are laid in London do in a very short time begin to wear in flakes. A cursory examination of these, before they were laid, would in most cases have shown that such would be the case,—the lines of lamination would be numerous and distinctly marked. We have seen flags which are closely striated throughout their thickness, some of the lines being dark brown,—almost black; others we have seen in which the striations only appear when the stone is wet; and others, again, there are,—we have a sample before us now,—in which even water will reveal no lines of lamination. We could point Sir Robert Rawlinson to flags, landings, and steps which are worn into hollows more than ¼ in. deep (owing to excess of traffic in particular places), and which yet do not show flakes. Just as there is good artificial stone and bad, there are good and bad flags. But there is another point which ought to be raised, and it is one on which Sir Robert gives no information,—are the best Yorkshire flags as durable as the best artificial ones? Of course, the instance mentioned by Sir Robert, of an artificial step lasting as long as three Portland stone steps, has nothing to do with our present subject.

NOTES.

THE coal strike terminated, as we anticipated, at the end of last week, the masters' combination not being complete enough to effectively resist the demands of the miners. The announcement that the dispute had been settled was naturally received with general satisfaction, and the incident, which created much alarm and uneasiness, will soon be forgotten. The most satisfactory feature of the affair, to our mind, consists in the statement that proposals were made at the conference for dealing with wages questions in future, and agreed upon in principle. It is time that such questions were settled in a more reasonable manner, for, as a contemporary well remarks, "the excessive cumbrousness and costliness of the present method of haggling were never better illustrated." The prejudice which exists amongst most bodies of workmen against arbitration has long been overcome in the case of the Northumberland and Durham collieries, where the representatives of employers and employed meet periodically for the discussion of disputed points, and have been successful in settling very many such questions. Indeed, Dr. Spencer Watson, of Newcastle, in a paper read at Manchester on the 12th inst., stated that in a single year no fewer than 629 disputes were thus settled; questions upon which agreement had been found impossible being referred for decision to one or more independent persons mutually agreed upon. These conferences have from time to time established sliding scales by which wages are automatically regulated, and it seems probable that had this system been more general the recent trouble might have been averted. The question is already before the House of Commons, a Bill having been introduced this Session "for dealing with strikes among workmen and remedying some of the evils of the sweating system." We should have thought that these two great labour questions differed sufficiently in their nature to have been made the subjects of separate measures. The Bill consists of seven clauses, and the principle of dealing with strikes may be described as compulsory arbitration. It is proposed to form Courts of Arbitration, consisting of an equal number of representatives of employers and employed, Her Majesty's Inspectors of Mines, —or of Factories and Workshops, as the case may be,—being empowered to compel disputants to submit their case to such tribunal when the differences are likely to lead to a stoppage of work. Should this result in the adoption of a mutually satisfactory arrangement which would obviate these vexatious and expensive disputes, it will certainly be most beneficial to the entire community.

IT is difficult to understand whence and how there first arose the idea of making a watering-place and holiday resort of Southend. Its distinction in that sense appears to date from about the last decade of the last century; at the time Jane Austen wrote it was regarded as a good seaside place to go to for a London man who could not afford the expense of a coaching journey to Cromer with a large family. Easy distance from London of course counted for a great deal more in those days; but why choose a place where there is a shallow a mile wide in front of the beach, only just covered by the sea at high water, and not leaving at low tide even a "practicable" sandy shore, but only a wet and muddy expanse? Yet Southend seems to be by no means quiescent, but rather putting on new life. In addition to Southend proper, which is reached from Fenchurch-street, there is now a kind of new hamlet springing up half a mile inland, called for distinction Southend-on-Sea (apparently because it is exactly the part which is *not* on the sea), reached from Liverpool-street, and where the well-built and rather ambitious new terminal station seems to argue that the Great Eastern Railway Company, at all events, expect a considerable traffic in that direction. New traffic is partly looked for, no doubt, from future residents on the building estates along the line of railway; on the Fenchurch-street line, for instance, between Tilbury and Southend, we pass a notice-board in the midst of fields, inscribed "authorised site of the ——— station" (the name has escaped our memory). But why people should go to Southend, except because more attractive places are full, we fail to understand: still less why they should go to Southend-on-Sea. There is no sea at the one, and no pretty country at the other. Southend itself, which formerly lined the shore, has spread up into a main street inland towards the railway: the usual watering-place street. The old town, irregular and dilapidated without being picturesque, but with an interesting old house here and there, skirts the shore eastwards, with a triangular plot of ground at the eastern part, between the houses and the sea, which seems to have been meant as a "village green" originally. On the high ground westwards of the end of the main street stands the principal hotel, and extending from it westwards is "Royal terrace," dating from the time when Southend was discovered; a neat clean well-built row of Georgian houses with pilastered front doors and a wide gravel walk before it, the centre of the terrace emphasised architecturally by stucco pilasters after the fashion of the day. In one of these it was, no doubt, that Mr. John Knightly stayed with his family on the occasion when he incurred the criticism of the Hartfield "apothecary," Mr. Perry, for his short-sightedness as a father in taking his family there instead of to Cromer (*vide* Jane Austen's "Emma"). Westward of Royal terrace extends, at a much greater length, the row of houses forming modern Southend. They make watering-places deliberately on a set pattern now, and this part of Southend is exactly like "The Lees" at Folkestone on a smaller scale; the houses, the drive, the turf margin, and the curving walks down the cliff side, are all repeated here: but there is not the Folkestone sea, unfortunately. From the bottom of the hill beneath the hotel extends the pier, a mile and a quarter long, enabling the visitor to get out to the water at low tide. The original pier was a rather narrow timber one, but a well-built erection of its kind, constructed about forty years ago. A new and wider iron pier is being carried out alongside of it, and is now about half finished. The end of the long pier is at all events a place to breathe fresh air and see a large expanse of sea and sky, as well as plenty of craft to give life to the scene. One real beauty of Southend, we can easily imagine, will be found in the effects of sunlight seen from the terrace, looking south across the broad estuary of the Thames, with the coast-line of Kent opposite. It was a fine scene on the day we saw it, lit only by the scanty sunlight of a rather bleak early March day: under certain conditions of weather there may well be splendid effects from the terrace level: the one real attraction we could fancy in Southend.

THE Town Council of Bolton has been bestirring itself, and not a moment too soon, if one may judge by the high death-rate in the borough in a recent week (43 per 1,000), and by the description which was given at its last meeting of some of the "rookeries" in the town. The present condition of the place is certainly deplorable. In many cases unoccupied cellar-dwellings are used as sahpits; back-to-back houses are common; people are living in "wretched shanties" clustered together in filthy alleys; sink-pipes are directly connected with the drains; the street-sewers are scarcely ventilated except into the houses; the public scavenging is done in a parsimonious manner; "a very large proportion of the cinder-sifting closets are now without rubbish-boxes, and, consequently, are in a highly objectionable condition;" in fact, sanitation appears to have been hitherto utterly neglected by the Council. These terrible charges are not made by any irresponsible person, but most of them by Dr. Sergeant, the Medical Officer of Health for the Borough. In his February report he further states that "the whole of Derby Ward has undergone inspection. The result shows that the sink-pipes of 1,330 houses were in direct connexion with the drains." The Sanitary Committee of the borough is now hard at work, attempting to remedy some of the existing nuisances; perhaps when the sink-pipes are all disconnected, other evils will be abated. A resolution has been passed ordering five houses in Meadow-street to be closed as unfit for habitation, and others are only waiting their turn. Ward by ward the whole town is to be purified. In Exchange Ward alone,—the first to be dealt with,—the committee found "scores of houses that required immediate attention." Houses that cannot be satisfactorily amended are to be pulled down. But the committee does not intend to build any dwellings to take the place of those demolished. This part of the sanitary reforms is to be left to "private enterprise,"—in other words, to the jerry-builder. This portion of the committee's report was subjected to considerable criticism at the last meeting of the Council. The main argument brought against those who advocated the erection of dwellings by the Corporation was the wearisome one of "economy." They would not "pay," or, as one councillor put it, they would not show "a satisfactory financial result." But it must be remembered that in providing sanitary dwellings for the poor, the larger taxpayers are not lengthening the lives of these alone, but probably their own lives too; fever bred in the slums will sometimes spread to the terrace and villa.

THE annual "Schinkelfest" of the Berlin "Architekten-Verein" was held as usual on the anniversary of the great architect's birthday. After the annual report had been read, and the (this time very long) list of members who had died during the year had been gone through, the representative for the Minister of Public Works presented the Schinkel Medallion to Herr Jules Boethke* (Kgl. Reg.-Baufuehrer), whom the President, on behalf of the members, congratulated in hearty terms. A very interesting paper on "The Life of the deceased Archæologist, Karl Boetticher," read by "Post-Baurath" Tuckermann, followed, the latter bringing Schinkel's and Boetticher's names in close connexion with one another,—and after a vote of thanks to the lecturer, a small pause in the proceedings of the evening followed, in which interval, however, a very fine collection of the archæologist's drawings could be viewed. After the pause

* See *Builder*, March 15, 1890, "Schinkel Competition."

the second part,—the annual dinner, with the various performances between courses,—took place, and, even if the tone was an earnest one on the whole, as time went on mirth had its rights. An allegorical piece, written for the occasion, titled "The Competition of the Building Styles," showed some excellent ideas, "The Style of the Future" being represented by a veiled warrior, clad in resplendent mail from head to foot; whilst "M. Rococo" showed a contemptuously comic figure. Ancient, Byzantine, Gothic, Italian, and German Renaissance were all typically represented: and "Culture," the controlling goddess of the piece, made an excellent impression with her strictly logical comments.

THE mausoleum for the deceased Emperor Frederick, now in course of erection at Potsdam, is progressing rapidly, but it is doubtful whether the building will be complete in time for the ceremony on the anniversary of the monarch's death, as was originally intended. The building, which has been designed by Professor Raschdorff (Hon. Cor. Member of the R.I.B.A.), in accordance with the Empress Victoria's ideas, or rather special wishes, is, as far as we can now see, likely to be a success. It will, however, be advisable to leave the description till after the opening ceremony. The site has been admirably chosen, and the style is in harmony with the surroundings and with the "Friedenskirche" close by.

IN regard to the subject of technical education it may be of interest to note that Austria has at present five technical colleges. A total of 1,760 persons are being benefited by the instruction given at these institutions, and of this number 1,576 are students proper. The Vienna College, with 788 names, takes the lead; the combined Bohemian and German divisions of the one at Prague show 501 (*i.e.*, 334 + 167) and then follow three smaller ones: Lemberg, 158; Graz, 157; and Brün, 148. Of the total of 1,760 names, only 152 have been entered for architecture. This is owing to the fact that the Austrian architectural students prefer to study at the "Kunst-Akademie" at Vienna. In comparing the above numbers with those of the German institutions,* we find that the number of students at the Royal Technical College at Berlin does not fall so very short of the number of technical students of the combined colleges in Austria.

IN a "Note" of May 4, of last year, we adverted to the establishment of a "Memorial Tablet Fund," at Newcastle-on-Tyne, for the marking of certain houses connected with the careers of its most famous townsmen. According to the *Athenæum* a similar project has been undertaken by the Clifton Antiquarian Club in respect of Bristol and Clifton. It appears, too, that the Club propose to extend their labours in a purely topographical direction, for "Roman camps and roads of the neighbourhood are likewise to receive annotations on their respective sites." Amongst the many worthies who should find special honour at Bristol, the names of the two William Canynges, who rebuilt St. Mary Redcliff Church in the fifteenth century,† John Shipward, Whitson, and Edward Colston, merchant-adventurers; Thomas Blanket, wool stapler, *temp.* Edward III.; and the Cabots and Hugh Elliott, navigators, are pre-eminent. John Cabot, together with his three sons, Sebastian, Louis, and Saucius, by the King's charter, sailed from this port in quest of India in May, 1497, and reached the Terra Prima Vista, by the gulf of St. Lawrence. In the year following Sebastian was equipped by his fellow-burgesses for a voyage which resulted in the discovery of the Labrador coast and of what are now Nova Scotia and Newfoundland. Passing on to later times, it is to be hoped that, besides Chatterton's, the haunts or homes of the following will be indicated. Coleridge sojourned at Clevedon and Bristol, being attracted thither by Southey, who was born in Wine, or Winch, street, where by the sign of the Hare, since the Golden Key, his father kept a draper's shop. Sir Thomas Lawrence, P.R.A., son of the landlord of the Black Bear Inn, Devizes, for a while stayed in Bristol, and set up, when sixteen years of age, in Bath. Jane Porter, novelist, with her sister, Anna Maria, natives of Durham, lived latterly in Bristol. Hannah More and her sisters kept a school here; their father was also a schoolmaster in the city. Also E. H. Baily, R.A., F.R.S., sculptor of "Eve at the Fountain," and of the "Graces" and the "Morning Star," whose father was a ship-carver at Bristol. Dr. J. C. Prichard, the great ethnologist, born in Ross, co. Hereford, who settled at Bristol in 1810, and in 1813 gave to the world his first edition of "Researches into the Physical History of Mankind." William Herapath, analytical chemist, inventor of the blow-pipe known by his name, and the magnetic balance, and who, with Henry Clark, founded (1828) the Bristol Medical School; Thomas Edward Bowditch, whose travels on the western coast of Africa were prematurely ended by his death at the Niger's mouth in 1824; and of Miss Mary Carpenter whose philanthropic labours need no encomium. We understand that a portion of Colston's house was incorporated in the new Assize Courts buildings.

* See *Builder*, February 22, 1890.

† Restored by the late George Godwin, F.R.S.

THE exhibition of the Institute of Painters in Water-colours may be characterised as

"Thin sown with aught of profit or delight."

The proportion of absolutely commonplace works seems greater than ever, and there are evidently a considerable number of people pursuing the craft of artist in water-colours who would have been better employed in some less ambitious calling. There are others worse than commonplace; large drawings hung on the line which are so absolutely vulgar both artistically and otherwise that to hang them in the best places in an exhibition is a kind of offence against public taste. The Hanging Committee do not seem to know what to do with some of the few really good works they have, as it is not uncommon to find a drawing that is quite above the average of the exhibition put down on the floor. Among the noticeable works Sir Jas. Linton's "Miss Ashbee" (16) is, of course, fine in colour, but very wooden and expressionless as regards the head; his other work, "Waiting" (441) is far superior—a beautiful face, picturesque costume, and very fine and rich colour. Mr. Slocombe's "Portrait of a Guarnerius Violin" (46), lovingly pourtrayed with its ruddy and amber tones, is an interesting and unusual work. Mr. Fulleylove's small drawing of "Greenwich Hospital" (127) shows a bit of bright breezy sky which in itself is worth a dozen of the ordinary run of works present. Mr. Anderson Hague's "Uncertain Glory of an April Day" (110) is a fine landscape effect rather spoiled by uncertain drawing of foreground figures and details. Mr. Cabianca's "Grey Weather" (137) is notable for originality of subject and composition—two white-bonnetted *réligieuses* flanked by a long dull grey wall and heavy masses of trees over it. Mr. Orrock's "A Common in Essex" (184) is a fine work, apparently a little wanting in foreground colour. In "Windsor" (211) Miss Donald Smith has caught the look of moving river-water on a calm day very well. "The Last Request" (248) by Mr. H. J. Dobson, is a truly pathetic little picture which has been floored, so that it is likely to be missed unless looked for. Not so with Mr. Charles Green's brilliant little work showing "John Gilpin" (282) proud and corpulent in his "trainband" uniform, admired by his wife and daughter, in a room every detail of which is given with the greatest finish and precision. Mr. Towneley Green's "Mother and Child" (284), with less of brilliant execution of detail, is a higher work in feeling; a kind of modern Ostade in water-colour. Miss Kate Greenaway's "Boy with a Basket of Apples" (295) is a kind of poetry-book boy walking in front of a prettily composed landscape; an original work, a little odd in colour. Mr. Fulleylove gives "Sta. Maria del Popolo from the Pincian" (296), a good little work of its class. Mr. F. Dadd's "Hawks Abroad" (303) is very cleverly painted, but wants point and incident. Mr. Gregory's little miniature, "A Step on the Stairs" (322) should be looked at. Mr. Arthur Severn sends a large study of "La Salute, Venice" (334), noticeable rather for colour than the treatment of architectural detail. Mrs. Harry Hine's "Study of a Street in Sunlight" (349) is slight but very true and bright in effect. Mr. Aumonier's large landscape (367) is hardly equal to his best. Mr. Dollman's "Hawks dinna pike out hawks' een" (427) is one of the now fashionable highwaymen subjects, clever enough, but the joke is hardly worth so much paper. Mr. Charles Green's "Pickwick Club" (435), with Mr. Pickwick standing on a chair for a benevolent speech, shows a great deal of study of character in the faces, but is not an attractive work; perhaps the subject is too near farce to admit of being seriously painted. Mr. Steer's painting of Goldsmith playing the flute to ragged children in his garret (452) is to be looked at, and Mr. Charles E. Wilson's "Blowing Bubbles" (471), a single figure of a child seated before the darkness of an open door. Mr. Carlton Smith's "Grace" (478), a family rustic scene, is not of the highest class of painting, but the expression of the child's head on the left is very sweet. In the third room Mr. Bernard Evans makes a landscape of the old school in "Byland Abbey" (545), effective in a way, but too like a revival. Mr. Hugh Carter's various figure subjects are all good, but all in too manifest and palpable imitation of Israels to give their author the credit he might otherwise gain from them. Mr. Knight's "Sheltered Vale" (639) is a fine work in his usual brown style; his smaller drawing, "A Breezy Day" (292) is better, however,—notably the bright windy sky. Mr. Chas. E. Mottram's "High Tide, Ramsgate" (634) is a very fine bit of sea-painting on a squally day. Mr. Harry Hine sends a large view of Lincoln Cathedral from the north-west (776), very correct and finished, but very deficient in tone and atmosphere.

A COLLECTION of paintings by various foreign artists, now on view at Messrs. Dowdeswell's in New Bond-street, contains a good many interesting pictures. Some of them indeed are small examples with great names, and those of Diaz do not tend to recommend him. One or two small Troyons are beautiful examples of the painter. Herr Muhrman's more or less impressionist landscapes are unequal but include some original things. Among works by modern Italian painters Innocenti's "The Dance" is a beautiful little picture. There are some fine examples of that remarkable and versatile painter Courbet, including two very fine landscapes, "Les Saules" and "Le Ravin," and an equally fine figure study, "La Dormeuse." There are also some remarkable works in their way, by Signor Segantini, who seems to be a kind of Italian Holman Hunt, or at all events reminds one a good deal of that painter in his tendency to very strongly marked and hard painting of detail, and strong contrasts of light and shadow. But perhaps the most interesting works in the gallery are the landscapes by the late Georges Michel. None of these are large, but they are all grand, landscapes; broad and powerful in effect and composition, and full of the poetry of nature. Michel's place will eventually be higher than it has been yet.

WITHOUT going beyond our *métier* to express any opinion on the great event of the past week in European politics, we cannot withhold a word of admiration for Mr. Tenniel's pictorial comment upon it, under the title "Dropping the Pilot." Among the many cartoons, full alike of artistic and intellectual power, which have illustrated Mr. Tenniel's

brilliant career as the chief artistic contributor to *Punch*, we do not know that he has ever done anything finer, more pathetic, and more straight to the point than this.

THE MAUSOLEUM AT CHARLOTTENBURG.

A WEEK or two since all the members of the Imperial Family of Germany in town at the time were present at the solemn ceremony held for the first time in the new extension of the Mausoleum at Charlottenburg, in honour of Emperor William I., the anniversary of whose death was the 9th of this month. The old Mausoleum building, designed by Schinkel as a tomb for the remains of Queen Louise of Prussia, was erected in 1810 (in accordance with Schinkel's design) by "Hofbaurath" Gentz, and received new façades of a more monumental material in 1826. In 1841 the Mausoleum was extended for the remains of King Frederic William III., and since that year this well-known monument has been visited by hundreds of people, not only on account of the patriotic interest of the place, but also on account of the two splendid sarcophagi it contains, the work of the sculptor Rauch. In accordance with an express wish of the late Emperor William to be buried in as close proximity as possible to his dearly beloved mother, the Mausoleum has again been extended, and there is now room enough in the upper chapel, not only for the two above-named pieces of sculpture, but also for fitting tombs for the deceased founder of the new German Empire and the Empress Augusta.

Seen from the front, the Mausoleum as it now stands does not seem to have been altered, although, in fact, the alterations have been of a very extensive and also difficult kind. The back wall of the building, and hence also the apse, or rather altar-niche, in this wall, had to be pushed back some five mètres, and the cupola over this niche, weighing about 800 cwt., had to make the journey as a whole, it being of great importance that the fresco on its intrados should not be damaged. These alterations and extensions have been designed by "Hofbau-inspector" Geyer, in accordance with the ideas of the late Empress Augusta, and the responsible position of architect in charge fell to Herr "Regierungs-Baumeister" Weber.

Upon entering the building we find that that part of Schinkel's design which was originally intended for Queen Louise's sarcophagus, but which now fulfils the function of a vestibule, has in its main parts been left as formerly intended. Passing between a couple of columns we find ourselves in the new, *i.e.*, extended chapel, which instead of having the long rectangular form of 1841 now shows a nearly square one, the present dimensions being 11·20 m. width to 11·60 m. depth, the altar-niche referred to above as being situated on the centre-line of the back-wall showing an opening of 4·50 m. diameter. This chapel, which is kept in light and bright colouring, makes an exceedingly good impression on the visitor, and the sites marked out for the sarcophagi receive good light through two windows on the sidewalls, each having a width of about 4 mètres. The ceiling is specially worthy of note—it is a coffered one, constructed, however, in iron and stone. Its ribs, which rest on the walls at a height of about 8·50 m. above the floor, are of ⊥ iron, placed 1·30 m. apart from one another. The lower and visible side of these girders shows a pattern in bronze and gold; whilst the square bays, which are of a fine grey stone, show a natural coloured margin as a frame to a deep blue ground, set out with metal rosettes in gold and white. The decoration of the walls is, of course, kept in the same strict Classic style as the remainder of the building. The flooring is of black and white marble slabs. The raised marble altar has not been altered, and has, together with the two very fine candelabra, found its old place in the apse.

Below the chapel we find the crypt in which the coffins of the deceased rest. This part of the Mausoleum can be as easily entered as before, the position of the entrances not having been altered. Passing through the old crypt, which now stands empty, and also serves as a kind of vestibule, we reach the sufficiently-well lighted crypt proper. Here four red granite piers serve to support the vaulted ceiling, and in the apse, which has a small window on the centre line, we see a plain altar of black marble. The floor is of this same material, and this, together with the dark-grey colour of the walls, gives the whole an extremely solemn effect.

FREE LECTURES TO ARTISANS AT CARPENTERS' HALL.

PROFESSOR KENNEDY ON THE FORTH BRIDGE.

THE fifth of this series of lectures was delivered on the 5th inst. by Professor A. B. W. Kennedy, F.R.S., Professor of Engineering at University College, London.

The lecturer, at the outset, remarked that he appeared more in the capacity of a showman than in that of a lecturer. When he was asked to give the present lecture he communicated with his friend Mr. (now Sir) Benjamin Baker, to ask whether he would be good enough to lend him (the Professor), for the benefit of his audience, a series of photographs of the bridge in its construction, which he had had prepared for showing in the lantern. Sir Benjamin acceded at once to his request, and really his (the Professor's) lecture would be a running description of the bridge illustrated by these photographs. When people wanted to put a bridge over a large river or ravine, there were three different fashions in which they could go to work. Supposing they were savages, the first manner in which they would go to work would be to put a tree trunk over it. If the savage grew to be an engineer, the tree trunk became a lattice girder, which was perfectly familiar to all those present. Failing the tree trunk, they might throw some kind of a rope across the river and attach a platform to it. The pré-historic rope had developed in our own time into the suspension bridge. But there was a third way in which the very oldest makers made bridges, and that was known as the cantilever principle. This very old fashion or type of bridge had had its latest development in the Forth Bridge, which was opened on the previous day. To show in what respect the cantilever bridge differed from the tree-trunk bridge or girder, and from the rope or suspension bridge, the Professor gave an illustration of the very earliest type of the cantilever bridge. The Forth Bridge had to be built across an arm of the sea over a mile in breadth, and the smallest length which could be got for one single span was a little over 1,700 ft. For certain constructive reasons it was impossible to bridge the entire span with a lattice girder. If the span had been bridged on the suspension principle the structure would not have been stiff enough to carry the enormous traffic for which it was intended, and there remained only the use of the cantilever type of bridge. The structure consisted of three piers—one on the north or Fife side of the river Forth, one on the south or Queensferry side, and the other in the middle, on an island called Inchgarvie. It was a very considerable engineering feat to build the Eiffel Tower on a firm foundation, but it was a much more difficult affair to construct the Forth Bridge, each span of which was equivalent to two Eiffel Towers built out horizontally. Views showing the progress of the undertaking from its initial to its final stage were thrown upon the screen, and the lecturer described the method of constructing the foundations of the piers, and the way in which the whole superstructure was erected. He concluded by expressing the hope that he had been able to give some kind of picture of the methods and course of construction of an undertaking which was one of the most remarkable as well as the largest of engineering structures of our time.*

PROFESSOR MARSHALL WARD ON "THE TREE, FROM THE SAPLING TO THE BENCH."

The sixth lecture of the course was delivered on the 12th inst. by Prof. H. Marshall Ward, M.A., F.R.S., F.L.S., &c., on the subject indicated in the above title. The subject was mainly treated from the arboriculturist's or forester's point of view, and was illustrated by a large number of views thrown on the screen by means of a lantern. It was a mistake, said the lecturer, to imagine that trees would grow anywhere, and it was another mistake to suppose that the aid of science was not necessary for their production and selection. True, the forester and the botanist did not *grow* the timber,—they *let* it grow,—but they had a good deal to say in the matter of the thousand-and-one vicissitudes which affected the tree as it grew, and the forester's art was based largely on the scientific experience of the botanist. The lecturer proceeded to describe some of the vicissitudes referred to, and to sketch some of the phenomena which the tree exhibited as it passed through its long life from the seedling to the sapling and thence to the tree cut up for timber to be used in the arts. He then proceeded to enumerate the kinds of trees which yielded the timbers employed in building. All over the world, except in extreme positions towards the poles, or on high mountain tops, we met with trees, but it was not every large tree which was a timber tree in the builder's sense. For instance, the tree-ferns of Ceylon and New Zealand, although their whole column-like trunks could be used for supports, would not cut into timber in the shape of planks or beams. The same remarks applied to many other trees, including the Talipot palms of India and Ceylon. The lecturer next proceeded to describe the often unsuspected infection of timber by fungi picked up in the forests. These fungi made their way into the timber by means of cracks or wounds, and they flourished at its expense, especially when the wood was damp and warm. If the fungus got into the log as it lay on the ground before it commenced its long river journey as a portion of a raft, the damp would cause the cracks in the log to close up, and the spore would lie as snug as possible in the log as the latter pursued its watery course. Then, when the logs were stored in the collecting-yards at the other end, the warm, damp, still conditions in the timber stacks just suited the fungus, and it surely but slowly made its devastating way along the interior of the wood. There were other fungi which could penetrate into the roots of a living tree, and then ascend the stem and gradually scoop out the heart from below, and make the trunk hollow. The lecturer said he had seen miles of fine-looking tall spruce firs in Austria the stems of which were hollow for several feet up, owing to the ravages of the pest referred to. Looking at a transverse section of a piece of timber, we saw the annual rings, in addition to the medullary rays, &c. Now these "rings" were really the expression of so many cylindrical layers of the structures composing wood, and they only appeared as "rings" because they were cut across. In all ordinary timbers one of them was produced each year, and the sharp line which separated them was simply due to the greater density of the structure in that part of the annual ring which was formed at the end of the summer. In illustration of this point, the lecturer showed a highly-magnified transverse section of Rhamnus, showing how the "annual ring" was marked by the sharp contrast between the more dense and compact wood formed in the autumn, and the more open spongy wood formed in the following spring. Passing on, the lecturer insisted upon the point that it was of importance where and how a tree was grown if it were to yield good timber. In illustration, he showed sections, side by side, of three specimens of spruce-fir grown under different conditions. They greatly differed in solidity and firmness of construction, and therefore in relative weight and hardness. Every timber had its own structural character. The lecturer, in conclusion, referred briefly to the ravages of dry-rot in the timber of floors, &c., and to the means to be taken to prevent them,—viz., dry air and good ventilation.

PROFESSOR UNWIN ON THE CONSTRUCTION OF WALLS.

THE seventh and concluding lecture of the course was delivered on the 19th inst., by Professor W. C. Unwin, F.R.S., who took as his subject "The Construction of Walls."

Professor Unwin, after some introductory remarks, said:—The architect and the engineer are both engaged in constructive work which in many cases is of essentially the same kind. Both alike have to build structures with pretty much the same materials and with the same object, that they shall support the loads they have to carry, and endure the destructive action

* The following illustrations of the Forth Bridge have been given in the *Builder*:—On January 2, 1886, we gave a general view of the bridge, two sheets of drawings showing construction of the superstructure, and a sheet of drawings showing the construction and placing of the caissons for the foundations. On July 16, 1887, we gave several sketches showing the progress of the work. On February 11, 1888, and May 26 of the same year we gave other sketches and diagrams showing the further progress of the work. On July 28 following we gave two views showing the progress of the three piers and of the Inchgarvie north cantilever.

of wind and rain. But there is in more respects than one a great difference in the way in which an architect and an engineer looks at a structure to be built. The architect always has to consider questions of appearance, of style of decoration as well as questions of stability or of strength. The engineer, on the other hand, pays but little attention to questions of this kind, but having, on the whole, larger and more severely loaded structures to build, he is obliged to consider much more carefully how his structure may be made safe with the least expenditure of material. There is another difference. The architect follows a profession of great antiquity, and for the most part has to erect structures of a common type and of similar materials. He hardly needs again and again to consider how strong his structures should be. That has been settled for him by long preceding generations of builders. With the engineer it is quite otherwise. He has constantly to construct structures of new types and to work in new materials. He is far less able to rely on precedent and far more often compelled to justify his action on scientific principles.

Now it would be presumptuous in me to lecture to you from the architect's point of view; but there may be some use in looking even at architectural constructions from an engineer's point of view.

The Materials of which Walls are Built.—Walls are built of natural stones or of artificial stones. I need not say much about either, but I want to point out one or two characteristics important to the builder. Natural stones may for our purpose be classified as *crystalline stones*, such as granite and marble, the former used as a common building stone in Scotland, the latter in Italy—both hard, durable, and strong; *slaty stones*, of which roofing slate is the commonest example, and used as building stone in Westmoreland and Wales. These are very strong and durable, but not easily cut to regular forms. Then come the great class of ordinary building stones, which are granular, or composed of grains, with a matrix of cementing material, and these are in two principal classes: the limestones, composed chiefly, sometimes almost entirely, of carbonate of lime; and the siliceous stones or sandstones, in which the grains are of silica. Some of the sandstones, especially when the cementing matrix is chiefly silica, are very durable. This and the facility with which they can be dressed make them very valuable for building stones. When the matrix contains alumina or lime the sandstone is less durable, sometimes quite dangerously perishable. The limestones, again, have a great range of quality. Portland stone, the merits of which Wren discovered, is one of the best and most durable of building stones. Other limestones will not stand the action of the weather, but are valuable for inside work. They admit of beautiful and delicate carving.

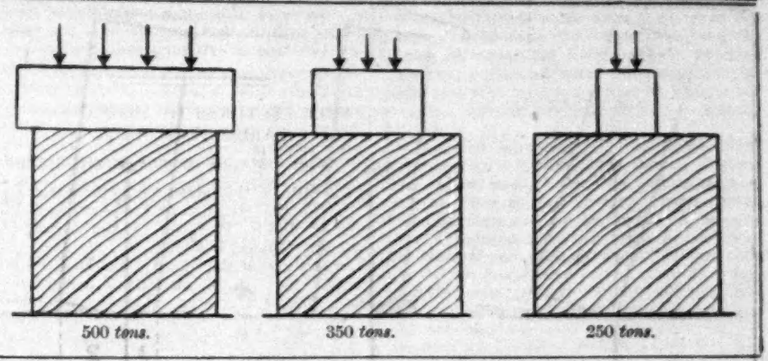
The durability of a stone depends partly on its chemical composition, as has been slightly indicated, but more on its hardness and resistance to absorbing water. There is no completely satisfactory test of hardness. But granite resists abrasion about three times as well as the hardest sandstones, and about ten times as well as marble, and about eighty times as well as Bath stone, the soft limestone we use for inside work. The absorption of water by stones is more easily tested. The granites in small blocks absorb less than 1 per cent. of their weight of water; the harder sandstones generally less than 7 per cent.; the limestones something like 8 to 12 per cent. Now, the importance of absorption is chiefly this, that if water absorbed by the stone freezes, its expansion disintegrates the stone; so that in selecting stone, the easy test of absorption gives really valuable information.

There remains one quality of stone which is of importance to the wall builder, and that is the strength of the stone. Almost always masonry is subject only to compression, and hence the measure of the strength of the stone for builders' purposes is its crushing strength. The following table shows some values:—

Crushing Strength of Stone.

	Tons per sq. ft.
Granite	1,500
Slate Rock	900
Sandstone, York Grit	700
" Mansfield	600
Limestone, Portland	500
" Ketton	300
" Caen	200

I should like you to understand a little more fully what those numbers mean, both as to their numerical meaning and their physical meaning. The diagram shows to scale a 1-ft. cube of red Mansfield supporting a cube 21 ft. in length of side. That 21-ft. cube has a weight which is just equal to the crushing strength of the 1-ft. cube. So much for the numerical significance of the numbers.



Next, what does the crushing strength mean? As a matter of fact, stones never crush at all. They shear along diagonal planes into tolerably regular pyramids.

Stone is tested usually in cubes, and great care is taken to get a uniform distribution of the load on the surface of the cube. At some value of this crushing load, reckoned on a square unit of surface of the cube, the stone quite suddenly shears along diagonal planes into a top and bottom and four side pyramids. If the crushing takes place in any other way, we may be sure the stone was badly bedded, and that the crushing resistance is less than for a well-bedded stone.

There is a special case which unavoidably occurs in building where the load, instead of being spread over the whole surface of a stone, is put on a small part of its area. Suppose a stone so strong that a cube of 1 ft. length of side would carry 500 tons uniformly distributed. If the pressure comes on the central half of its area it would crush with 350 tons; if on the central quarter of the area, with 250 tons. If the load is eccentric, or if the pressure area is diminished below as well as above, the strength is still further reduced. Now, the practical importance of that is this,—that it shows us how necessary it is that stone should be well bedded if its strength is to be depended on.

There must be unequal pressure of the stones on each other in actual structures, and hence experience has taught us never to load our structures to anything near their crushing strength. There are very few structures in which the average crushing stress in the masonry reaches 10 tons per square foot. A few great piers or pillars of churches carry more. Some of the pillars in St. Paul's are believed to be loaded to 18 tons per square foot, and, in very rare cases, double that stress seems to be safely carried. One remarkable case is the great chimney at St. Rollox, where, on the brickwork, the stress is believed to reach 30 tons in a strong windstorm. Generally, for rubble masonry, the stress does not exceed 1 ton per square foot, or for ashlar 5 tons.

Artificial Stones.—Bricks are well known to us in London, as they were, indeed, to the Romans, from whom we have derived much of our modern constructive methods. Bricks vary much more than stone in strength, in porousness, in hardness. There are bricks made of slate refuse, blue in colour, very dense, very heavy, which carry, fairly tested, 1,000 tons to the square foot. For some engineering works they are invaluable. Staffordshire blue bricks will carry 400 tons. But most ordinary building bricks do not carry more than 100 to 150 tons. There is another thing about brickwork. So far as we know, masses of brickwork are materially weaker than single bricks. I suppose this must be due to the impossibility of getting uniform and perfect bedding, even with mortar-joints, in such compound masses.

Limes and Cements.—We shall see that in the older wall constructions no mortar or cement was used. In later times a greater use has been made of cementing material, so that some reference to this is necessary. The cementing materials now used are:—Fat limes; hydraulic limes; hydraulic cements.

The fat limes, produced by calcining nearly pure limestones, slake violently when mixed with water, and when made into mortar with sand, harden very slowly by absorbing CO_2 from the atmosphere. The mortar made with lime and sand only is even at the best of times very poor stuff from an engineer's point of view. It has little strength, little tenacity, little adherence to stone or brick. Really, the ordinary mortar used for walls can be regarded as little better than so much convenient packing material, which serves to give the stones or bricks a fair seating on each other, and to distribute their pressure evenly. In many Mediæval structures, where mortar of this kind has been used in large quantities for filling of piers and walls, it has remained unset and unhardened to this day, and some disasters to great architectural buildings have come from this cause.

The Romans ten centuries ago had admirable and strong cements, made from volcanic material. In mediæval work and in modern work it was common to use the poorest kind of cement, made almost entirely of lime and sand. It was known to modern builders that certain limes which slaked very slowly had the property of hardening under water, and were much stronger when set than ordinary limes. The property of these hydraulic limes was traced to their containing a proportion of alumina and silica, which in burning were brought to a condition in which, when ground and mixed with water, slow chemical combination and crystallisation went on. Then it occurred to some manufacturer to artificially produce this mixture of lime and alumina and silica, and so, about 1850, a new cement called Portland cement was introduced, which has proved of quite extraordinary value in building work. It is not too much to say that some of the great masonry walls I shall speak of presently could not have been built without it. It is immensely stronger and more trustworthy than lime of any kind. Its only fault is its cost. Lately a cheaper cement has been made from slag, almost as strong as Portland cement, with the same quick-setting property, and probably much less costly. It promises to be very valuable to the builder.

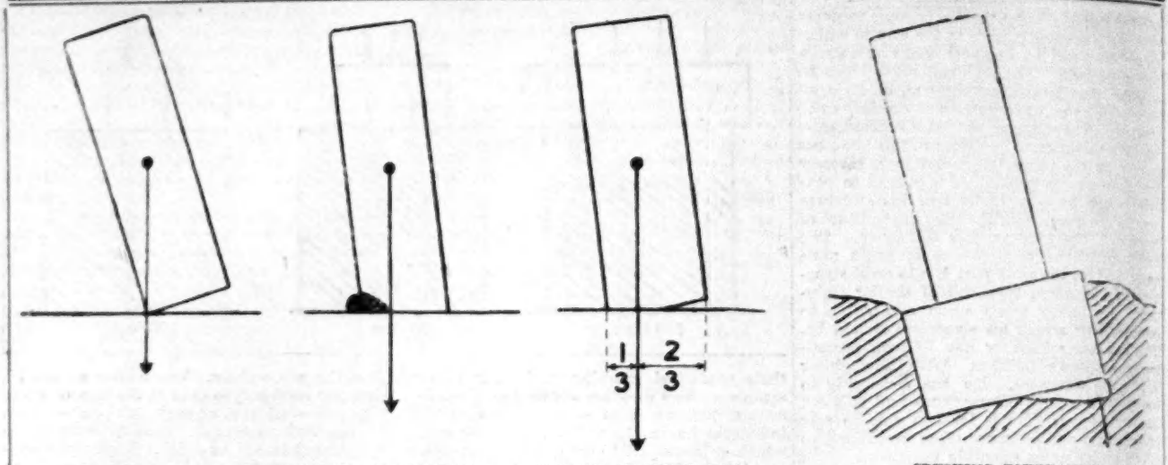
Walls.—The object of a wall is to be a fence,—a fence against enemies, like the Great Wall of China, or the early city walls, like those of Tiryns and Mycenæ or our own London Wall; a fence against weather, like dwelling-house walls; a fence against the slipping of embankments, like the retaining walls of railways; or a fence against water, like some of the great masonry dams. Constructionally the fortress-wall, the house-wall, the retaining-wall, and the dam are very little different except in size.

A wall rests on the soil, and if the soil is weak, its base must be spread out by footing-courses, or a concrete bed must be prepared. But I have not time now to speak of foundations, excepting just this, that a large part of the disasters to walls have arisen from the weakness of the foundation; and one object in giving a good deal of strength to a wall is just this, to enable one part to help another if the foundation under it partially fails.

The walls of Tiryns and Mycenæ are of large blocks (each so heavy that two oxen were required to move it), packed with smaller stones, but without mortar.

The earliest walls of importance which still exist in Southern Europe are known as Cyclopean, Pelasgic, or polygonal walls. In their roughest form they consist of unworked, or nearly unworked, stones of large size, packed with smaller stones. But in the finest Cyclopean walls the stones are worked so as to bed fairly on each other. The stones are irregular prisms, with plane-worked faces on ends and beds. Such walls have no mortar.

Now, it must soon have been perceived that, on the whole, it was more convenient and practical to work the stones to a regular



OVER-TURNING. CRUSHING AT OUTER TOE. TENSION AT INNER TOE. CRUSHING FOUNDATION.

Ways in Which a Wall Gives Way.

prismatic form. So we get what we call ashlar. I give a diagram of a characteristic form of Greek ashlar masonry, the stones in each course being of equal height and fairly bedded with broken joints. The Greeks frequently built without mortar, and the stability of their walls depends solely on the weight of the blocks.

Now, it was not always convenient to find stone large enough to build in that way. Then came the method of building walls with faces of brick or stone and a rubble interior. Bonding stones at intervals connect the two faces. Such a wall may still be a block-work structure depending on gravity for stability.

More commonly, however, and especially in Roman building, the rubble interior is a concrete of strong cement and stone, and may be as strong or stronger than any other part of the wall. The Romans obtained from volcanic ash a splendid cement, and so originated structures in which the resistance to destruction depends not on the mere stability of the blocks, or the resistance to displacement due to their weight, but on the strength of the cemented mass. For the cement makes the wall practically a monolithic structure, and every part helps every other part. Pushing this new principle of building further, the Romans became the originators of rubble work, in which quite irregular stones are bedded in cement mortar, and the structure depends almost entirely on the cohesion of the mortar to the stones and its resistance to shearing and crushing.

You see, then, there are two absolutely different principles of building. In the Greek method, a pile of uncemented stones, each member resists displacement only by its friction due to the weight resting on it. The bedding of the stones is due entirely to masons' skill. In the Roman method the soft mortar makes the bedding without any skill at all, and, when set, forms a solid mass of a strength sometimes little inferior to stone itself.

Bond.—The bonding of stones or bricks, or placing them so as to break joint, is commonly insisted on as very important, and so, no doubt, it is, with the ordinary kinds of weak cementing material which are used. A properly-bonded wall has strength to resist shearing or tearing apart, quite irrespective of any adhesion of the mortar. But without bond it would have no strength. When we come to use really strong cementing material then the importance of bond vanishes. For instance, here is a block of cement concrete which has been crushed. The stones were without any proper bond, and yet in crushing the fracture has run almost indifferently through cement and stone.

Suppose, however, we have no cement, or a very weak cement, how must the stones or bricks be placed? I will consider brickwork as the simplest case. There are three quite distinct objects in properly placing or bonding the bricks. First, by placing the bricks properly any pressure coming on one is distributed widely to the bricks below, so that the inequalities of pressure on the lower and heavily strained courses are reduced.

Next, if the bricks break joint the wall cannot shear without cutting through the bricks themselves.

Lastly, quite apart from any tenacity due to the mortar, the wall gets a resistance to tearing apart horizontally. In order that the wall may tear apart, the overlapping portions on one side must slide on those below; but in consequence of the weight resting on these overlapping portions there is frictional resistance to sliding.

Let us call the resistance to this horizontal sliding the longitudinal tenacity of the wall. Obviously the longitudinal tenacity of any course of brickwork is proportional to the height of brickwork above it, so that the longitudinal tenacity of the whole wall increases nearly as the square of its height; but the longitudinal tenacity also depends on the amount of overlap, and hence we shall find the longitudinal tenacity varies with different arrangements of the bricks. It is greatest if the courses are all stretchers, for then the overlap is half a brick length. In English bond and Flemish bond the overlap is a quarter-brick length, and they have the same longitudinal tenacity.

But now generally walls have more than one course of bricks in their thickness. Then these courses require bonding together, or the wall will split into two thicknesses, and, indeed, in some Mediæval walls this has happened. The tenacity across the wall is dealt with in the same way as the longitudinal tenacity. We get the greatest transverse tenacity by putting the bricks all headers. In English bond the transverse tenacity for a 9-in. wall is double the longitudinal tenacity. In Flemish bond the transverse tenacity is less.

In the London Building Act there is a provision that the openings in a wall should not exceed half its area. Now, that strikes an engineer as a somewhat remarkable provision. I imagine there can be no reason for such a rule, except the necessity of preserving the longitudinal tenacity of the wall. Of course, the openings do diminish the tenacity, and that seriously. I have on the wall a sketch of one of the houses in Sicily shaken by the great earthquake of 1857. You see the wall has failed from end to end from imperfect tenacity, and is torn by cracks roughly normal to the direction of the earthquake wave. Further, most of these cracks have elected to pass through the wall openings. Now, a rule which merely takes note of the area of wall openings ignores the conditions which secure longitudinal tenacity altogether. Under the rule, it is possible to cut up the wall into vertical strips, leaving the wall no longitudinal tenacity at all. Surely, if there is to be a rule of this kind, it should be so framed as to secure a reasonable connexion in the parts of the wall. If for a shop-front, a very large part of the wall is cut away; then the rule should provide that the tenacity destroyed should be made up for by iron, which, in fact, is commonly done.

There is a passage about the bonding of bricks in one of Smeaton's reports which is worth referring to: "There are even some workmen who suppose that nothing more is required of them than that the bricks should be properly bedded and the work level and perpendicular. But the workman who would attain perfection must acquaint himself with the different arrangements of placing (bonding) the bricks so that one part of the work shall strengthen another."

Now you know that Smeaton built the Eddystone Lighthouse, and that structure was probably the most remarkable instance of perfect bonding ever erected in mason's work. It would have stood the impact of the waves almost as perfectly without mortar in the joints as with it. The courses in plan look more like ingenious Chinese puzzles in stone than ordinary mason work. Now, Smeaton's lighthouse has had to be removed, not from any weakness in the tower itself, but because the rock on which it stood was being undermined, and a new and larger tower has been erected. I give a diagram which shows the bonding adopted in this case. The dovetail joints are filled with Portland cement, and the tower is probably as strong as a monolith of granite.

Resistance of Walls to Crushing and Overturning.—Looking at a wall from the engineer's point of view, the first question which has to be considered is how strong it ought to be. Curiously enough, I suppose that the thicknesses of walls required in modern building Acts are not based on any scientific examination of what a wall has to do, but purely on precedent extending back to Roman times. One great French engineer, Rondelet, did (a century ago, nearly) undertake a scientific investigation of the proper strength of walls, and he based his calculations largely on an examination of ancient Roman walls which have stood the storms of eight or ten centuries. There are standing now at Tivoli the lofty walls of Hadrian's palace. Rondelet found that these walls had a thickness of one-sixteenth of their height, and that is not widely different from the thickness which would now be required in strong and lofty buildings.

If a wall has to sustain a vertical load only it is easy to see what in an extreme case its form must be. Some thickness is required at the top for constructive reasons, and that thickness will be sufficient for a distance below the top. But at some distance below the top we shall come to a joint where the stress due to the superincumbent weight reaches the safe working limit of stress in the material. It may be one ton or five tons per square foot, according to the quality of the materials and the factor of safety we wish to allow. Below that level the wall must be splayed out, and we may so arrange the splaying that the stress on every horizontal section is the same. All the material will be at its working limit of stress, and the wall will then be of the most economical form possible.

But generally speaking the vertical load is not the most dangerous of the straining actions to which walls are subjected. If walls give way it is not often by direct vertical crushing but by some kind of overturning.

In lofty buildings in exposed positions the wind is the most dangerous force to which a wall is exposed. In this country wind-storms giving pressures of 30 lbs. per square foot on vertical surfaces in exposed places occur every year, and in specially-exposed places a wind-pressure of 50 to 60 lbs. per square foot has been registered. Such a lateral pressure tends to overturn a wall, and is the most dangerous action to which it can be exposed.

The precise way in which a wall gives way by overturning should be understood. In some

cases the pressure on the toe of the foundation may cause the foundation to yield. It is easy to provide against that by giving adequate width of foundation. Generally the resultant pressure on the base of the wall is kept in the middle half of the width of the foundation. In other cases the wall gives way by opening a horizontal joint and overturning.

In most books, the overturning of the wall is treated as a question of stability. The wall is regarded as perfectly rigid, and a calculation is made of the force required to make it turn over on one of its edges. The wall is taken to be stable enough if it would require from two to two and a-half times as much force to overturn it as the greatest force likely to come against it.

The wall would be just on the point of overturning if the resultant of its weight and the horizontal pressure on it just passed through one of its edges. To put it another way, the wall is just on the point of overturning if the resultant force at any joint deviates from the centre by half its thickness. For safety, the actual moment to which the wall is subjected should not exceed half or two-fifths of this.

Now against this, as a practical rule, I have nothing to say. It provides, in most cases, stability enough. But it assumes a mode of overturning which, in lofty structures, could not possibly occur. The material of the wall is not strong enough to support a wall on its edge as supposed. Before any such overturning could begin the wall would crush near the edge. Hence, in lofty walls, it is much more rational to design the wall for some safe limit of crushing pressure than for some moment of overturning.

There is another accident in walls which needs to be provided against, especially in walls which have to resist a pressure of water. Supposing we cannot depend on any great adhesion of the mortar to the stones, then, in most cases, before there is any tendency to crush the one edge of the wall, the joint opens at the other edge. If the mortar is weak the joint opens if any tension occurs, and there will be tension if the resultant pressure at a joint deviates by as much as one-sixth of the thickness of the wall from the centre of the joint.

Hence, to sum up: If the resultant pressure deviates by half the thickness of the wall from its centre the wall must overturn, and the edge will crush with a less deviation than this. Further, the joints will open on the tension side unless the adhesion of the mortar prevents it, when the deviation is only one-sixth of the thickness of the wall.

Now, if these principles are applied to determine the stability of ordinary walls of buildings, I think most architects will be surprised to find how small the stability of their walls is. No doubt in towns the wind-pressure seldom strikes against buildings with any great force. No doubt, also, most ordinary buildings have cross-walls, which add enormously to their stability. For ordinary purposes the ordinary proportions given to walls are, obviously, sufficient, for very few buildings fall down, and, when they do, some very obvious cause of bad material or weak foundation is almost always discoverable. But buildings have to be put up in exposed places, and sometimes great lengths of wall are built without support from cross-walls, and in such cases the architect should be aware of the risk he runs.

I have calculated out what may be termed a limiting case, a wall of indefinite length, standing alone, without support from cross-walls or floors.

The wall is 70 ft. high, and of at least as great thickness as any ordinary mill wall. I have supposed that besides its own weight it has to support a horizontal uniform wind pressure. I have calculated the wind pressure necessary for each of the stories to bring the walls to two conditions,—first, the wind pressure which would cause the resultant pressure on a joint to deviate one-sixth of the thickness of the wall from its centre. I think an engineer would take that condition as the limiting condition of safety. Secondly, I have calculated the wind pressure which would make the resultant pressure at a joint deviate by half the thickness of the wall. It is certain that the wall must overturn with a less pressure than that, unless (what is very improbable) a considerable adhesion of the mortar could be relied on.

Now the pressures arrived at are rather strikingly small. It seems that the wall would become unsafe with less pressure than 5 lbs. per square foot, and must certainly overturn with 12 lbs. per square foot.

Mr. Arrol gave in evidence that every temporary work even in connexion with the Forth Bridge was braced so as to resist a wind pressure of 40 lbs. per square foot. Bearing this in mind, the stability of the wall to stand alone certainly seems inadequate.

Now, if I were really going to investigate the stability of a building, I should have to go a step further. It would be necessary to consider whether the cross walls gave any support, and whether the floors were capable of transmitting any of the pressure to the back wall.

As to the cross walls, I may be wrong, but I fail to see that when the cross walls are at distances so great as 100 ft. apart they can render any effective support to the middle part of the wall.

As to the floors, the case is somewhat more difficult. But, I suppose, on the most extremely favourable assumption as to the action of the floors, they could only be assumed to transmit half the pressure to the back wall. If they did as much as that, the stability of the wall would be doubled. It would carry twice the wind pressures tabulated above. But even then the stability of the wall would seem somewhat too small to an engineer.

It can hardly be hoped that the floors will do as much as this. They are not built with any object of supporting the walls, but for a quite different purpose. If they are to fulfil that function, they should be designed with that end in view. Next, the long, elastic, and flexible joists can only transmit pressure to the back wall in proportion to the amount of the yielding of the front wall, and any yielding means a diminution of stability. Lastly, the load of the floors must itself in general be so applied to the wall as in general to diminish rather than increase the stability of the wall. If the weight of the floor comes on the inside edge of the wall, it may very seriously diminish the stability.

Most buildings in towns, no doubt, are never subjected to any appreciable wind pressure at all. They are screened by neighbouring buildings from any direct impact of the wind. All I want to draw as a moral from this discussion of wind pressure is this: architects should bear in mind that wall thicknesses which may be amply sufficient in the ordinary case of buildings in towns, may prove insufficient in more exposed places, and especially when a building has abnormally little support from cross walls. Further, I should like to see building rules take note of the fact that this cross support is important. All rules I have seen make the thickness of a wall depend only on its height. With walls as thin as those commonly built, it seems to me that the thickness should also increase when there is a great distance between the cross walls. Church architects do act as if this were their principle. They do make a much larger use of buttresses than is common in civil architecture.

Most of you must have heard of a lamentable disaster which happened at Glasgow in November last. A large mill, in course of erection, was blown down, and many lives were lost. The mill had the joists of the floors on, but not the floors, and was not roofed. It was probable, therefore, that it was exactly in the condition least favourable for resisting wind pressure. Not only was the wind directed on to the face wall by neighbouring buildings, but also, as Mr. Arrol pointed out, probably the wind found access through the window openings, and produced some, though probably a small, pressure on the back wall. It was given in evidence in the inquiry before Commissioners that the walls were of rather more than usual thickness, that they were well and strongly built, and that in all respects the owners of the mill had taken care to have a strong, well-built, carefully-designed mill. Now, notwithstanding this, the mill fell with disastrous consequences, and that in a storm of wind which, according to the evidence, was not of exceptional fury. There is no doubt, I think, that, like the Tay Bridge, the mill was blown down.

Reservoir Dams.—I now come to deal with walls of another kind and of a greater size, but strictly walls, and performing essentially the same functions as other walls.

In all countries, and for a long period, it has been necessary to husband the water-supply derived from the rainfall, by storing it in the wet period of the year, for use during the dry period; or to reserve water falling in cycles of wet seasons, to use years after in cycles of dry seasons. Sometimes the object has been the storage of water for town's supply, in other cases the storage of water for irrigation. In either case very large quantities of water must be stored, and the mode of storing it is much the same.

In some valley draining a sufficient catchment basin an artificial lake is formed by damming up one end of the valley by a wall of earth or masonry. The water accumulates behind the dam, and can be drawn off by suitable appliances at the times when it is needed. That is the simple idea of water storage. To carry it out under the varied conditions imposed by natural and artificial restrictions has taxed the resources of generations of engineers.

Anyone who will look at a tolerably large-scale map of Southern India will find that the river lines look like necklaces of beads. All along every river course chains of storage reservoirs or tanks were constructed for irrigation purposes by the ancient owners of the soil; for without the irrigation water in the dry, hot season, the soil was almost uncultivable. Thousands of these tanks dot the map. In course of time many of these tanks silted up, and it has been one of the greatest tasks of the English rulers of India to restore these old tanks, and to bring abandoned land again under cultivation.

In Northern Europe, and in quite modern times, the aggregation of the population in large towns has caused also an urgent want of regular supply of large quantities of water for drinking and sanitation, and the increasing pollution of the rivers has forced us to construct large numbers of storage reservoirs precisely on the plan of irrigation tanks.

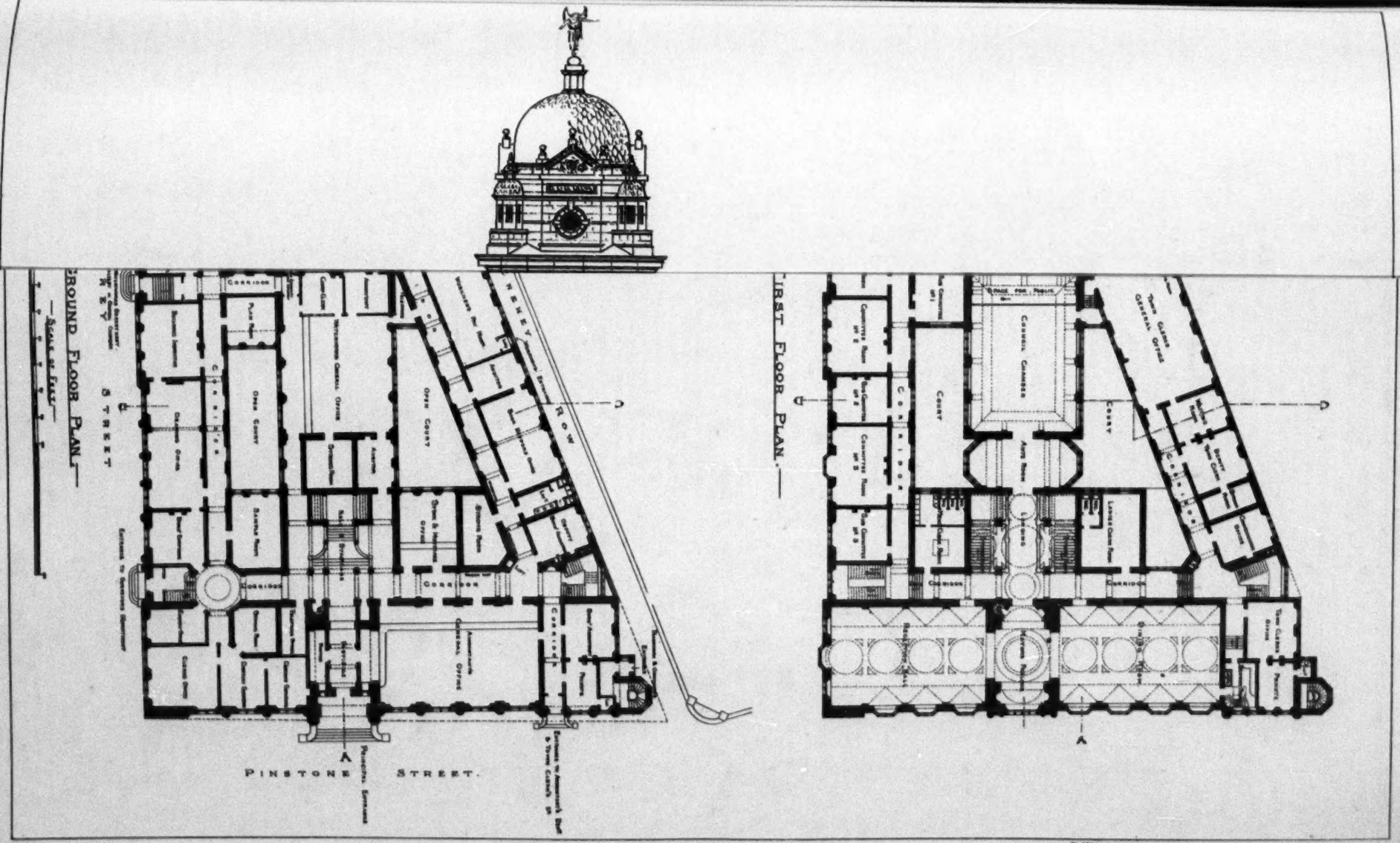
In this country it was till lately the custom to form the storage reservoir by throwing a huge earth-bank across the valley from side to side. Such earthen dams are really walls of a peculiar type. Some of them are from 100 to 120 ft. in height, and one-eighth of a mile to half a mile in length They are not unadapted for moist climates and for positions where a rock foundation is not attainable. But they are subject to two very serious kinds of danger. The water may creep through them, and if it does, it very soon enlarges its passage-way in the loose material and destroys the dam; or the water, accumulating in some violent rainstorm, may overtop the bank, and if it does, it very soon cuts down a gap which sets the waters free. Disasters of the most serious kind have happened in both these ways.

In 1864 the Dale Dyke reservoir burst at Sheffield, and 114,000,000 cubic ft. of water rushed down the valley, destroying an enormous amount of property and causing the loss of 200 lives. In that case the water crept through the dam and undermined it. Only last year the Conemaugh Dam in Pennsylvania burst, the water overtopping it and cutting a gap. In that case 3,000 lives were lost. There have been other cases.

Now, there are cases where only an earthen wall can be constructed, and for heights up to 100 ft. no doubt, with care and foresight, an earthen dam can be made safe; but it is not wonderful that engineers should have sought for some securer way of doing battle against the enormous pressure of the water. Earth dams are built of cheap materials, it is true, but as they are loose banks, with no coherence, an enormous mass is required. On the other hand, a stone wall is much dearer per cubic foot, but if much less material is wanted it may be cheaper than an earthen dam. At any rate, it is to stone walls that engineers have looked as safer and stronger than earth banks.

The first condition of a stone wall to resist water pressure is that it should be free from fissures. But a high wall cannot be free from fissures if it is built on a yielding foundation, or a porous foundation through which the water can find a way. Hence masonry dams are only built on rock foundations. We now believe that on a sound rock foundation reservoir walls can be built which may remain uncracked and undecaying for centuries, and may be almost as permanent as the hills.

Masonry dams of quite gigantic size were built in Spain two or three centuries ago. Naturally, the Spanish engineers were the first in modern times to construct a masonry dam. A great masonry dam was built at Puentes in 1802, 150 ft. in height. Unfortunately, it was built on piles; it was undermined when the reservoir first filled, and broke, causing a loss of 600 lives. Probably the disaster at Puentes



SHEFFIELD MUNICIPAL BUILDINGS COMPETITION: DESIGN SUBMITTED BY MR. W. CAMPBELL JONES, A.R.I.B.A.

made engineers reluctant to build stone dams for some time. However, in 1858 the French Government was directing attention to storage of water, and it became necessary to construct a dam on the Furens river, 165 ft. in height, in a narrow gorge. The engineers decided to have a masonry dam, and for the first time investigated scientifically exactly in what form such a dam should be built. The older dams were trapezoidal, and it is easy to see why such a form should be chosen.

If, as is natural, we look chiefly to the condition of things when the reservoir is full, we see we have two forces to deal with—the horizontal water pressure tending to overturn the dam, and the vertical weight of the masonry tending to prevent overturning.

Suppose the weight of the masonry is double that of the water, and the base of the dam three-fourths its height, then in a triangular dam the resultant pressure on each joint comes just within the middle third of the width—a condition we have seen to be one of the conditions of stability. Now the triangular form is not convenient, but the trapezoidal is an approximation to it.

Liverpool was one of the first towns to obtain power for the supply of water by the Municipality, and very fine reservoir storage works were constructed at Rivington between 1852 and 1857. Then Liverpool adopted constant-supply in 1864; however, in a long drought, constant-supply had to be suspended, and at one period in the next year the available water in the reservoirs only amounted to ten days' supply. Various expedients were adopted from that time to this to make the supply adequate for daily requirements till a new source of supply could be found and the necessary works carried out. The most important remedial measure was the introduction by Mr. Deacon, the Water Engineer, in 1873, of a system of measuring the flow in the mains of each district by recording meters termed waste-water meters. As soon as systematic observations were made, it was discovered that a quite enormous waste of water was going on in consequence of leaks in the mains and faulty house-fittings. By preventing this waste, without restricting any legitimate use of the water, the supply has just been made adequate up to the present time; but Liverpool has more than once been on the verge of a water famine, and a new supply was a matter of the most urgent necessity.

Now in these times there is only one way, in most cases, of obtaining a supply large enough for a town, and pure enough to be healthy. This is, to seek the water on some remote hill-valley, where the rainfall is abundant and the streams unpolluted. Many sources of supply were examined. The English lakes, Ullesswater, Howeswater, Windermere, and Bala Lake in Wales were all considered. But a natural lake is not always a favourable source of supply. To get the water out of it you must tunnel beneath its bed, and, more than this, you have generally the need to raise its level and increase its storage capacity by damming up its outlet. Further, round most lakes population has aggregated, the land is valuable, and the drainage is no longer unpolluted. Other districts were considered, but finally a lonely valley in mid-Wales was selected, down which flows the Vyrnwy, one of the tributaries of the Severn. The valley is an old glacier-bed lying 780 ft. above the sea, and high enough to send its waters to Liverpool, seventy miles off, at a pressure then sufficient to command all parts of the town. The moorlands rise to a level of about 2,000 ft. all round the valley. The rainfall is copious and the land uncultivated. The rocks are slate, interspersed with beds of very ancient volcanic ash. Here it was that the Liverpool Corporation decided to create a new lake as large as Bala Lake itself by damming up the outlet of the valley. The dam, 1,172 ft. in length, has been built. During the past year the waters were allowed to gather. A quite beautiful lake, five miles in length, occupies the old dry valley-bottom. The small village of Llanwddyn, the only one in the valley, is submerged. The pipe-line is laid, seventy miles in length, and when, early next year, the tunnel under the Mersey is finished, Liverpool will have an abundant supply of the purest possible water. The whole cost of this great municipal work reaches nearly two millions, and as a great engineering enterprise it takes rank with the Forth Bridge and the Manchester Canal,—monuments of knowledge and skill and organisation and enlightened expenditure. The area of lake is 1,121 acres; the volume of water is 12,000 million gallons; the greatest depth of water, 84 ft.

Now, of the scheme of water-supply it is not for me here to speak in detail; but the great dam which closes the valley and forms the lake is strictly a masonry wall. In some respects, it is the greatest of all these great masonry dams hitherto built. It is not quite so high as the Furens and Villar dams, nor quite so wide of base as the Vervier dam; but it is much longer than these, and has a much greater cube of masonry; and it is the first great masonry wall of this kind built in this country by English engineers.

Then, if masonry is to be used, what kind of masonry should be adopted? Should it be a great block-work structure, the ashlar blocks set in Portland cement to make the joints watertight? Well, I suppose it would have been impossible in any reasonable time, at any practicable cost, to hew the rough but hard and strong slate rock of the valley into ashlar blocks. Had it been possible it is probable it would not have been best to do so, for a blockwork mass has a regular system of thin joints, which form planes of weakness throughout the mass. It is just possible that by some settlement fissures might be formed, taking definite directions along these joints and leading the water into the core of the work. A system of rubble work, with its irregular joining, seems liable to no such danger. Hence a system of rubble masonry is adopted in all these great masonry dams, the structure being rendered almost monolithic by bedding the rubble stones in the strongest cement.

At the Vyrnwy the masonry is really of a new type. It is rubble masonry of quite gigantic blocks. The limit to the size of the blocks is determined by the power of the lifting machinery at the quarry and on the work. With steam cranes it was possible to handle and set blocks of seven or eight tons' weight. Each block, selected with quite curious skill by the mason to fit its neighbours, was dropped into a soft bed of cement-mortar, and every accessible crevice packed with smaller stones and concrete. On the faces only of the dam the blocks are squared.

The slate rock on cubes carries 800 tons per square foot. The concrete in cubical blocks 180 tons. As the concrete is in comparatively thin layers between the cyclopean blocks the strength of the masonry of the dam is probably not inferior to that of slate rock itself.

Before beginning the dam an immense trench was opened across the valley, the whole of the alluvial and glacial deposits being removed and the underlying rock exposed. The greatest part of the mass of the dam is thus below ground. The form is not widely different from the theoretical form required. The height from the rock foundation in the middle of the dam is 127 ft., and the width at ground level 101 ft. Two great culverts are constructed through the dam. Through one a stream of 10,000,000 gallons a day flows to feed the Severn, while the water-supply of Liverpool, which may reach 40,000,000 gallons a day, is taken through a tunnel in a lateral bay of the lake.

A very great danger for most reservoir embankments is the discharge of surplus water if a flood occurs after the reservoir is full. For most reservoirs a by-wash or channel is constructed to lead away the surplus water down the hillside to a point below the dam. But many have been the disasters due to insufficient provision for discharging floods. The Vyrnwy dam forms an immense weir over which surplus flood-water will flow, finding its way harmlessly in a comparatively thin sheet down the outer face of the dam to a water cushion below.

I have given some particulars of the strength of masonry structures. Under no conditions can the crushing stress in the Vyrnwy dam exceed 9 tons to the square foot. In fact, the crushing stress is slightly greater on the inner toe when the reservoir is empty than on the outer toe when the reservoir is full.

The masonry dam alone,—apart, that is, from the pipe-line and service reservoirs and other great works which are necessary for the conveyance of the water,—has cost over half a million. In no other masonry work has the true principle of rubble building, the using of a cement so strong that the structure becomes practically a monolith, been so rigidly carried out.

A visitor with large experience of masonry work made this report about it:—That the Liverpool people had in this dam a piece of masonry not surpassed for solidity by any masonry in the world.

Illustrations.

SHEFFIELD MUNICIPAL BUILDINGS COMPETITION DESIGNS.

We publish this week the elevations and principal plans of four of the designs sent in for the first competition for the Sheffield Municipal Buildings, all of which were specially mentioned in our review on January 25 last of the designs that were exhibited. We have others to publish at another time. We have considered it would add to the interest of the plans to publish several together for the purpose of comparison.

The first one is that by Mr. R. A. Briggs. We quote the following passages from the report which accompanied the drawings:—

"It will be seen from the plans and sections that, although the present building will be quite complete as designed, still the future extension can be added without any detriment to it.

The fall in Surrey-street has been made use of so that a lower ground floor is obtained towards that street and Norfolk-street, and the Health Office Department has been placed on that floor, the sill of the windows of that department being at least 2 ft. above the level of the street.

No tower has been shown on the accompanying design, as the author desires it to be distinctly understood that the building as designed can be built well within the sum mentioned, viz., 80,000*l.*, but he desires to point out that a tower could be easily added without any detriment to the plan, but rather with a considerable enhancement to the building. It may be mentioned that a design for such a tower has been prepared, and the arrangement of the plan will allow of its being added over the grand staircase at an additional cost of 7,000*l.*, without any alteration to the plan being necessary.

The principal entrance leading to the hall has been placed as suggested toward Pinstone-street, having three entrance doors, inside which swing doors will also be placed to prevent draught. The height of this hall will be 17 ft., with steps up to main ground-floor, this arrangement giving a very imposing effect, and at the same time obtaining greater height for the hall.

The entrance hall gives immediate access to the vestibule, where the two grand staircases are placed for the Mayor's apartments and council-chamber.

Two general entrances have been placed, one in Norfolk-street and one in Surrey-street. There is also an entrance in Cheney-row, with a service staircase for the kitchens and workmen. It is proposed that a roadway be made to this entrance from Pinstone-street.

The council-chamber on the first-floor has been placed with windows looking into the court, this being the position most favourable to the essential condition of quietness for the room. The author believes that ample light will be obtained through the windows looking into court, but a ceiling light is also provided. A gallery, reached by the general staircase towards Surrey-street, is provided, and there is also a small subsidiary iron staircase inside the room.

The ante-room, with circular glass dome, gives access to the council-chamber, and a side passage is also provided, in order that Councillors may not be obliged to enter always through the ante-room.

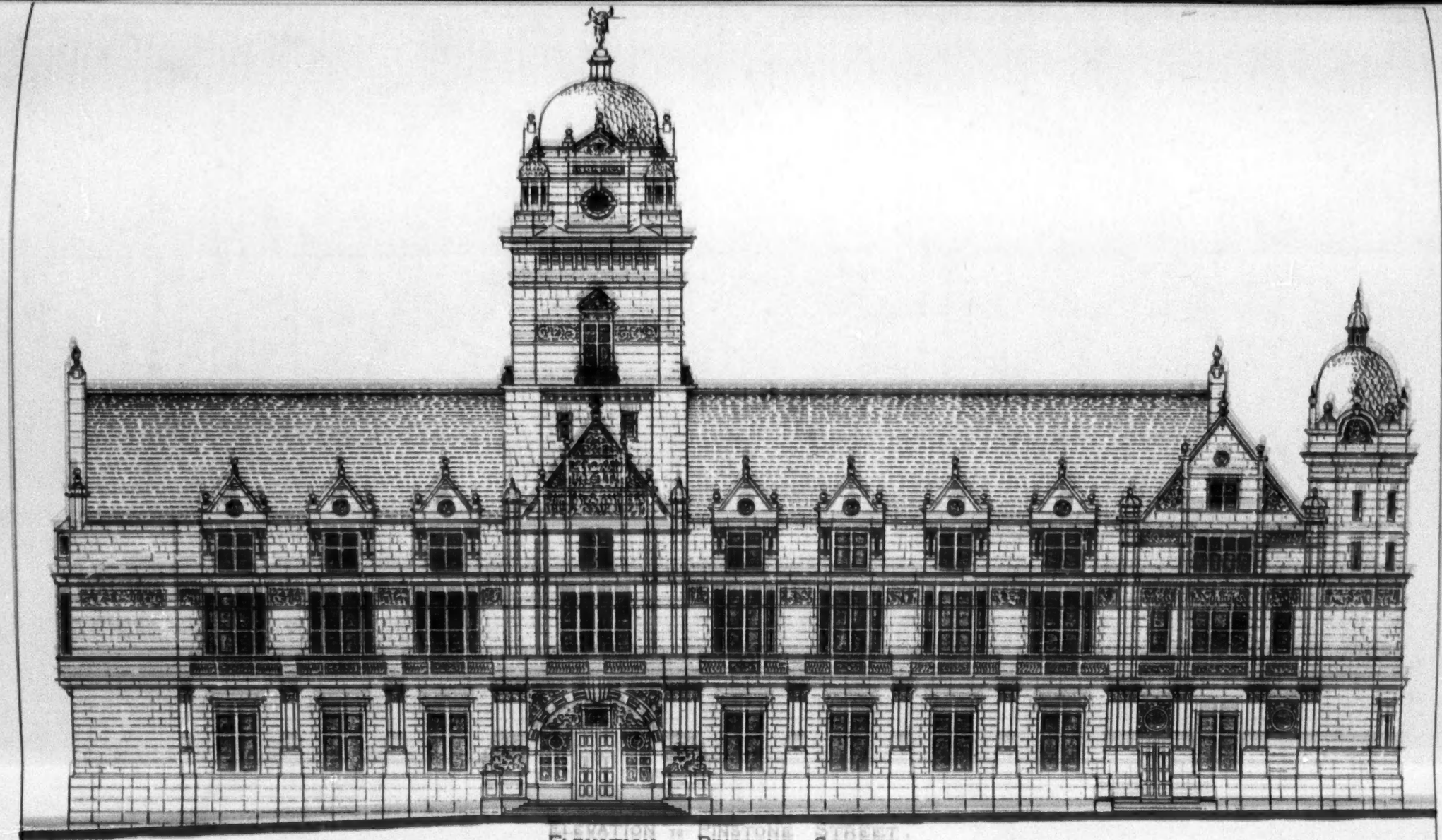
Two cloak-rooms are placed next the rooms above mentioned, being easy of approach to the council-chamber and the Mayor's apartments. W.C.'s and lavatories are provided in these cloak-rooms, and urinals might also be placed in one of them if desired. A small cloak-room, with lavatory and w.c., is also provided for the private use of the Mayor.

The reception-hall, dining-room, and Mayor's parlour are placed *en suite* facing Pinstone-street, so that they may be used together if desired, and patent sliding doors, 4 in. thick, and filled with slag-wool as a non-conductor of sound and heat, will divide them into three separate rooms when necessary.

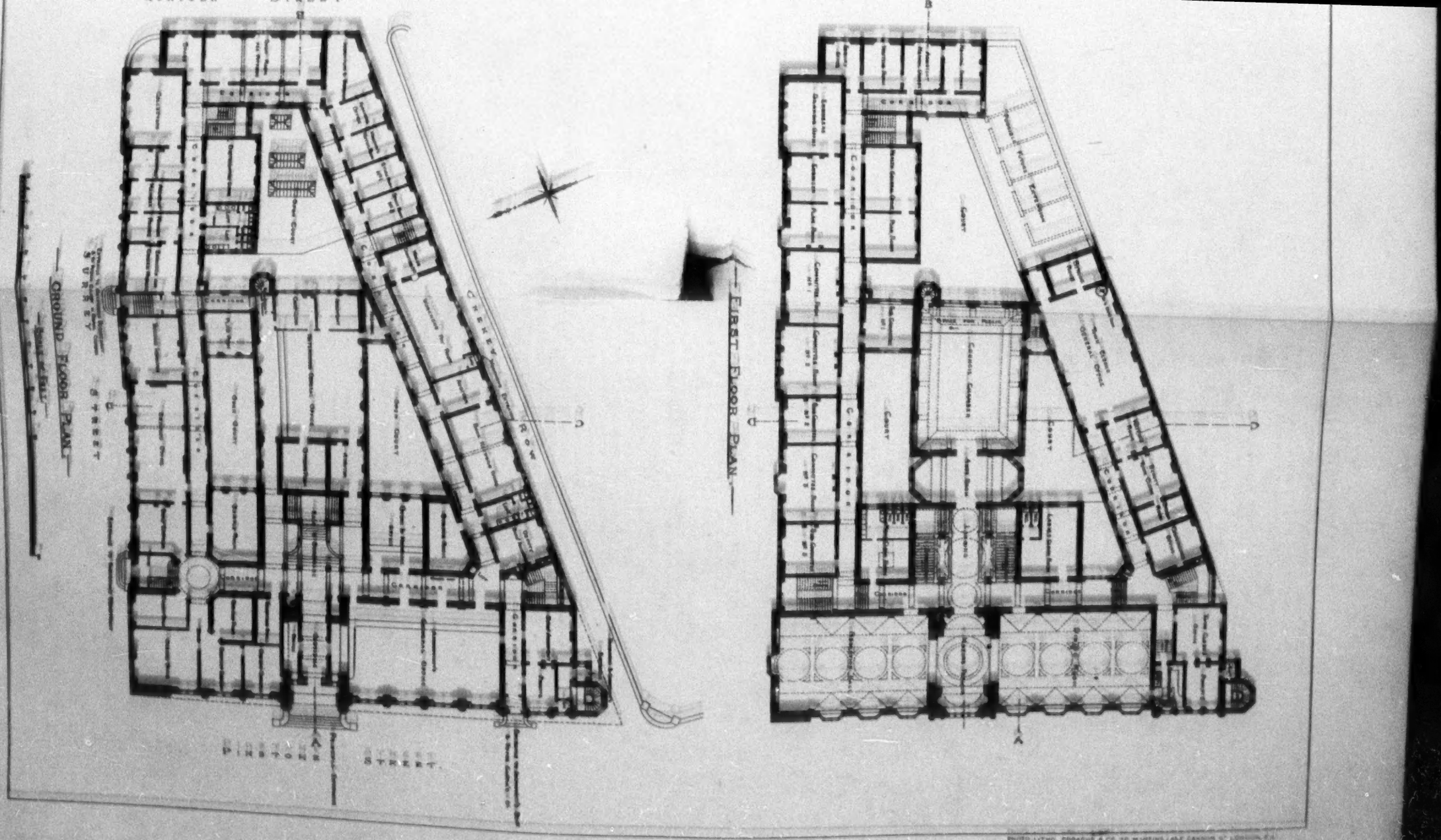
The Borough Accountant's office is placed in the position which is most ready of access and central in position, corridors giving easy approach from any entrance. The staircase (towards Cheney-row) gives ready access to the wages-room on the basement.

The two large public lavatories, being well lighted, have been placed at the corners of the front towards Pinstone-street, with entrances direct from Surrey-street and Cheney-row, these being considered the most convenient positions. This arrangement will in no way interfere with the appearance of the building.

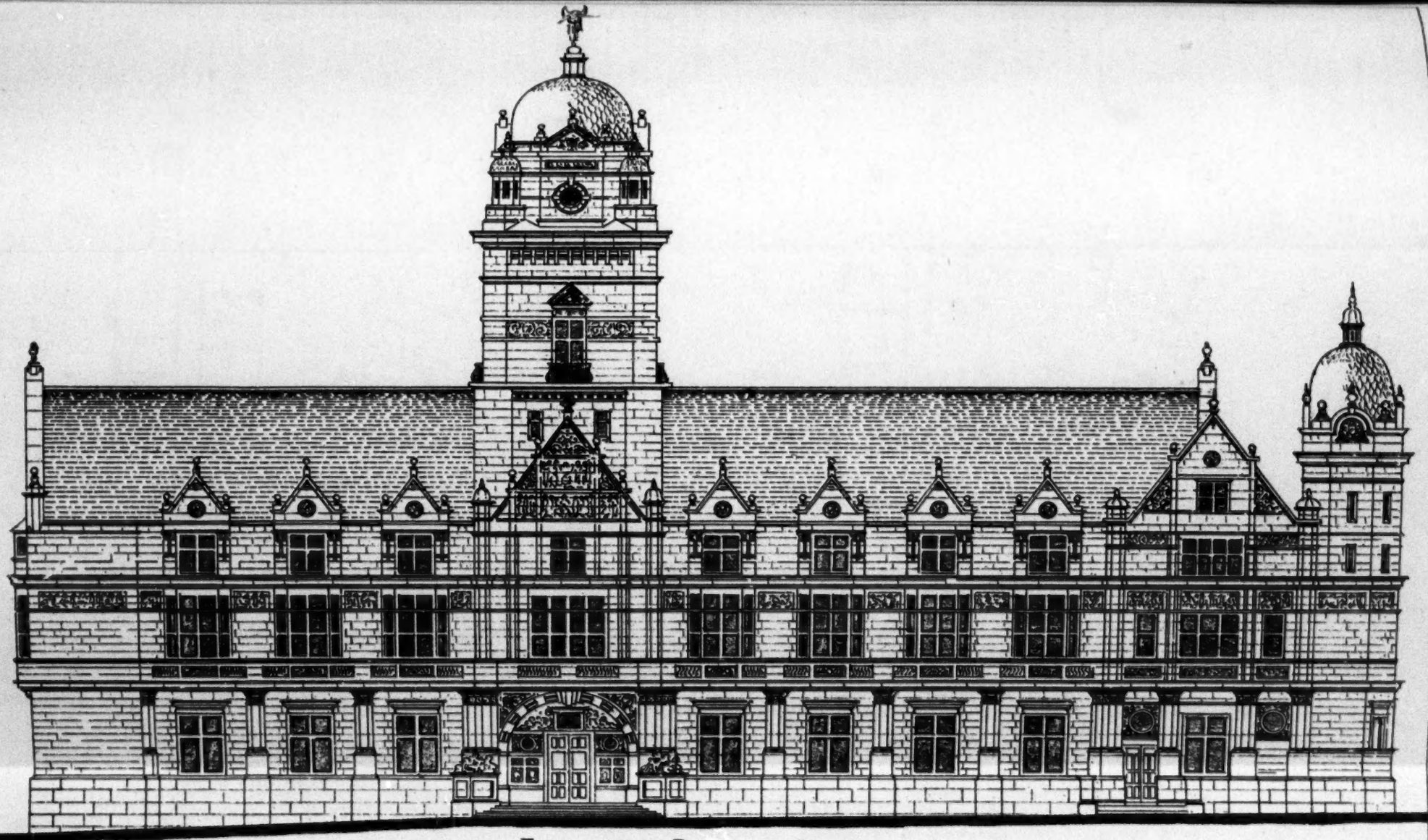
The arrangement of the plan has been studied so that every department may be separate and complete in itself, but at the same time convenient to the other departments; as, for instance, folding doors could easily be placed to shut off the Mayor's apartments from the Council Chamber and likewise these rooms from the Town Clerk's offices.



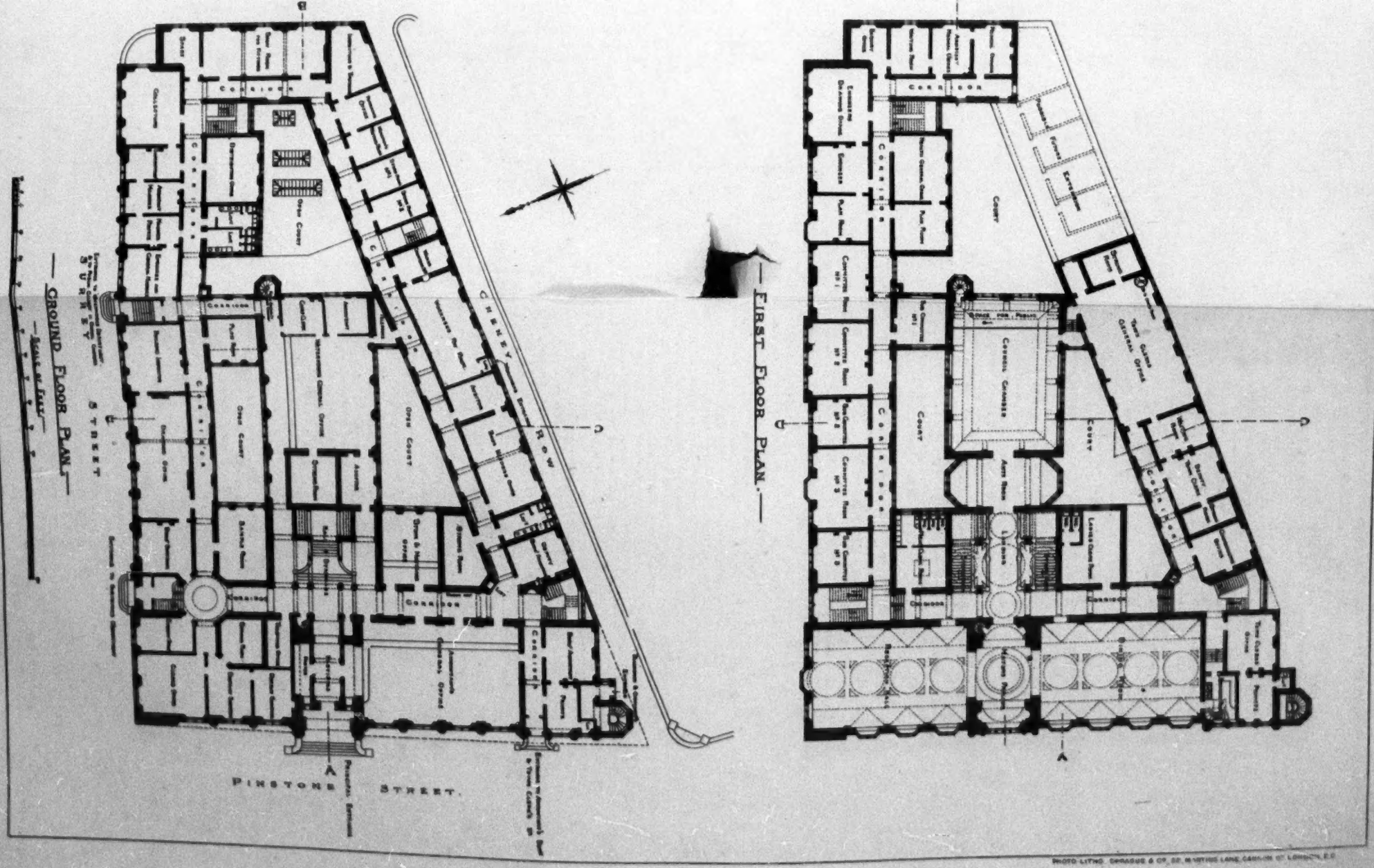
ELEVATION TO PINSTONE STREET.



SHEFFIELD MUNICIPAL BUILDINGS COMPETITION: DESIGN SUBMITTED BY MR. W. CAMPBELL JONES, A.R.I.B.A.



ELEVATION TO PINSTONE STREET.



SHEFFIELD MUNICIPAL BUILDINGS COMPETITION: Design submitted by Mr. W. Campbell Jones, A.R.I.B.A.

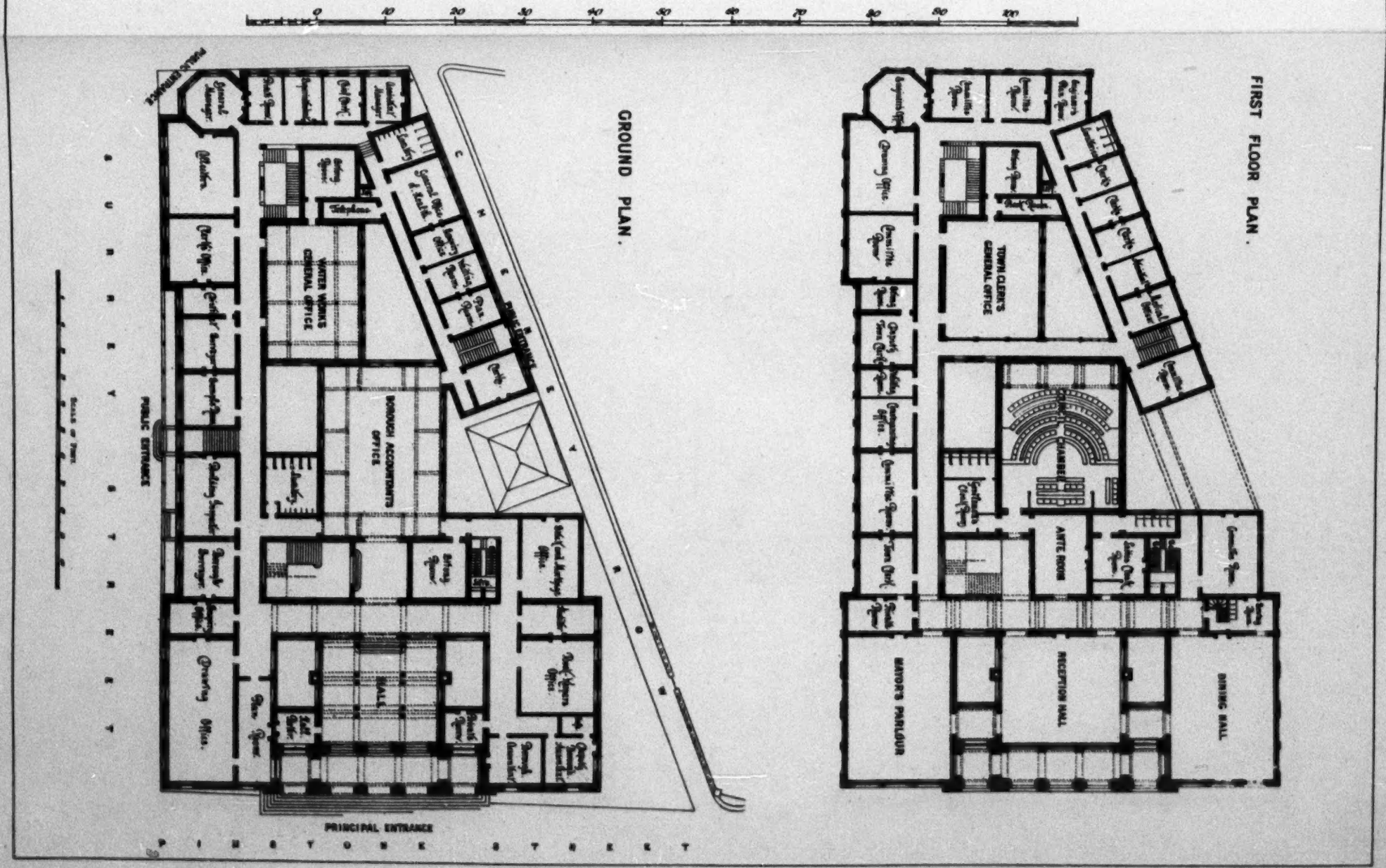
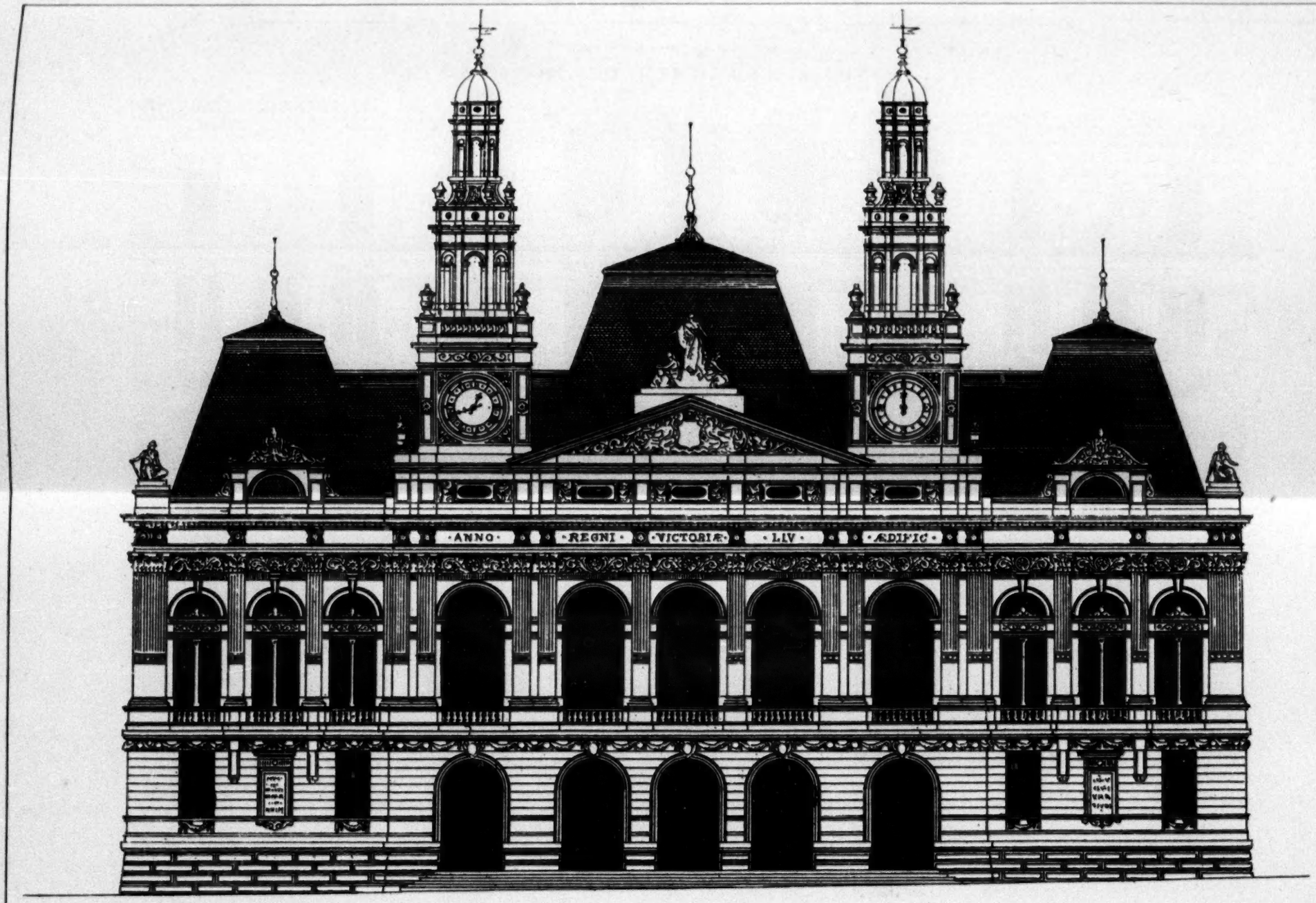


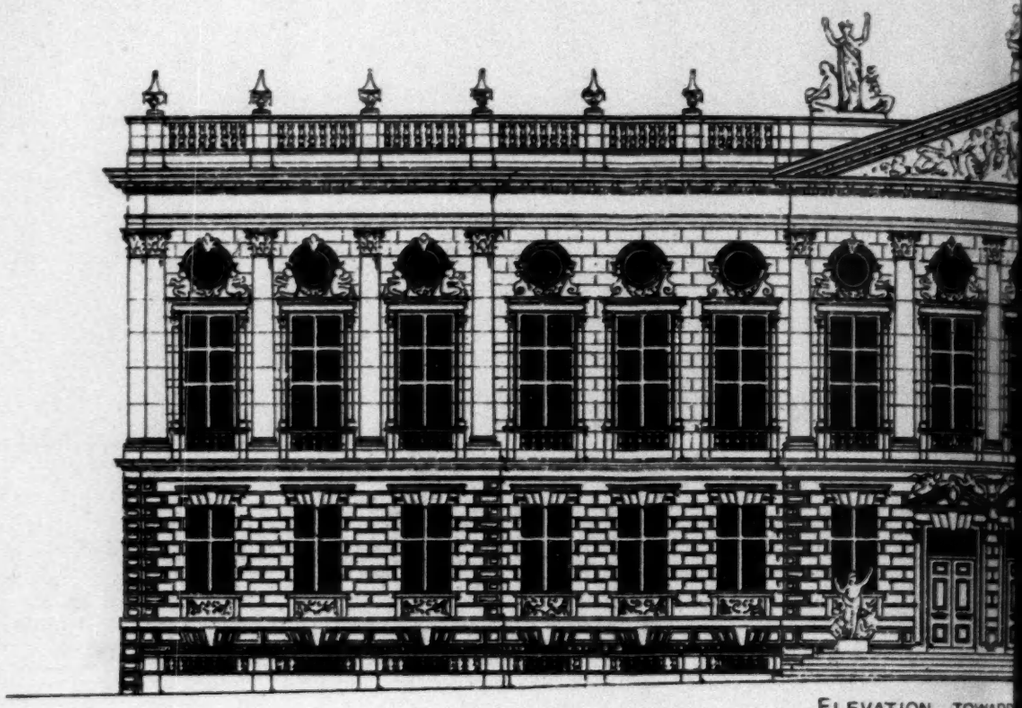
PHOTO-LITHO. SPRAGUE & Co., 62, MARTINS LANE, CANNON ST., LONDON, E.C.

SHEFFIELD MUNICIPAL BUILDINGS COMPETITION.—Design submitted by Mr. John Robinson.



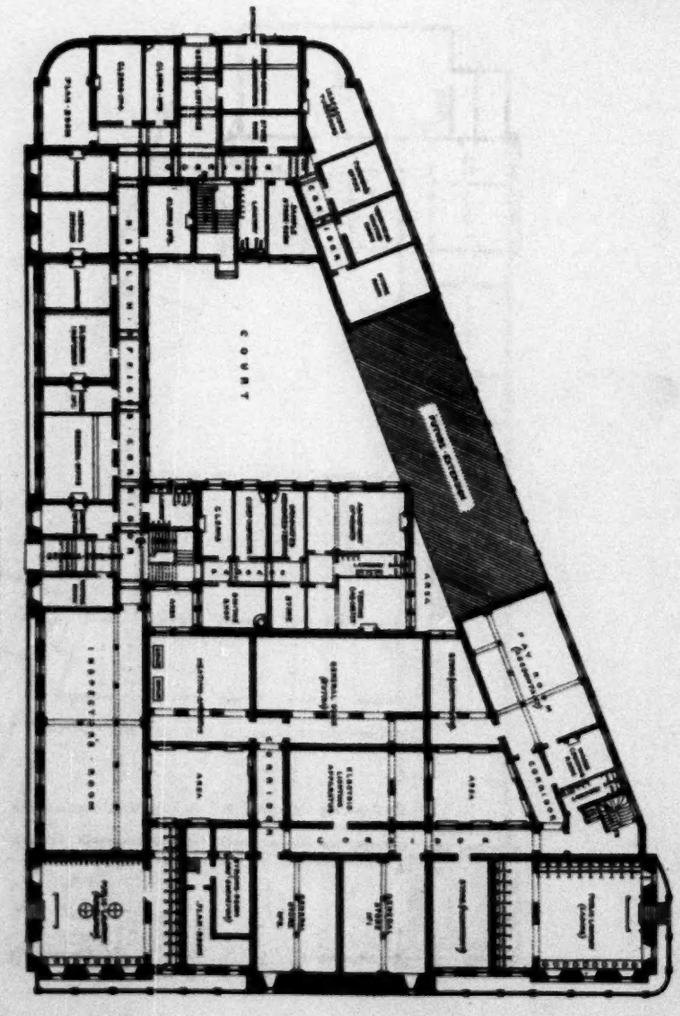
ELEVATION TO PINSTONE STREET

SCALE OF FEET

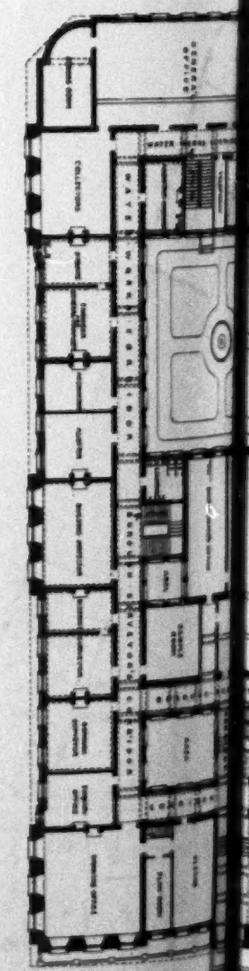


ELEVATION TOWARD

SCALE 10 5 0 10 20 30

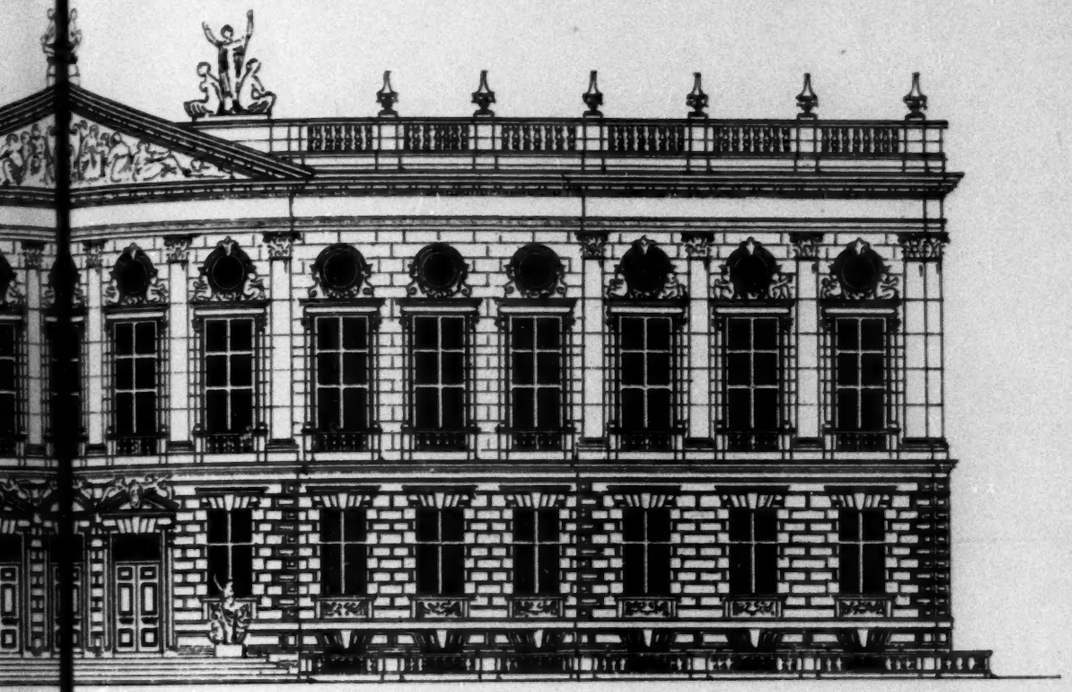


LOWER · GROUND · FLOOR OR BASEMENT · PLAN



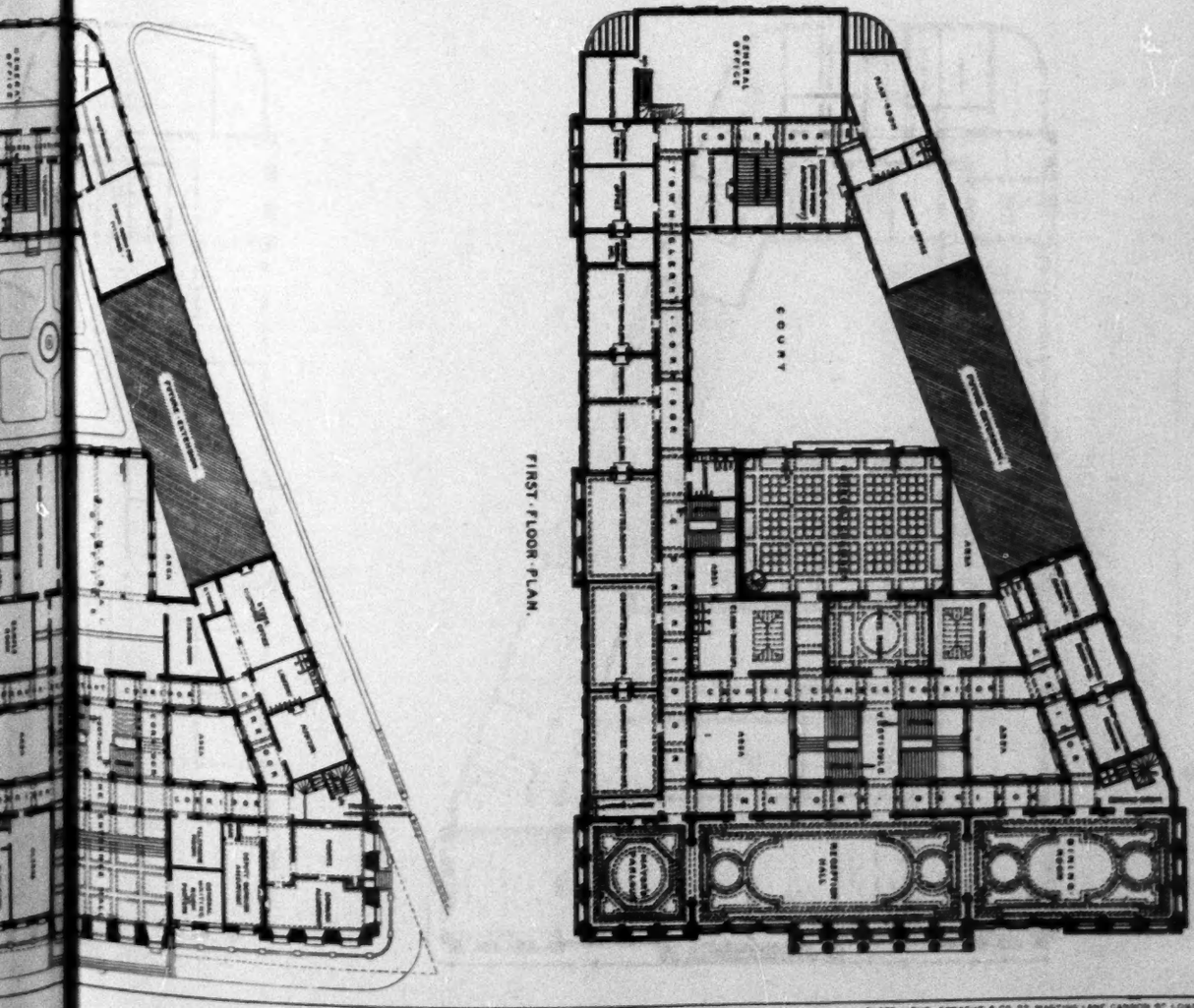
GROUND · FLOOR · PLAN.

SHEFFIELD MUNICIPAL BUILDINGS COMPETI



TOWARD PINSTONE STREET.

0 10 20 30 40 50 60 70 80 90 100 FEET.



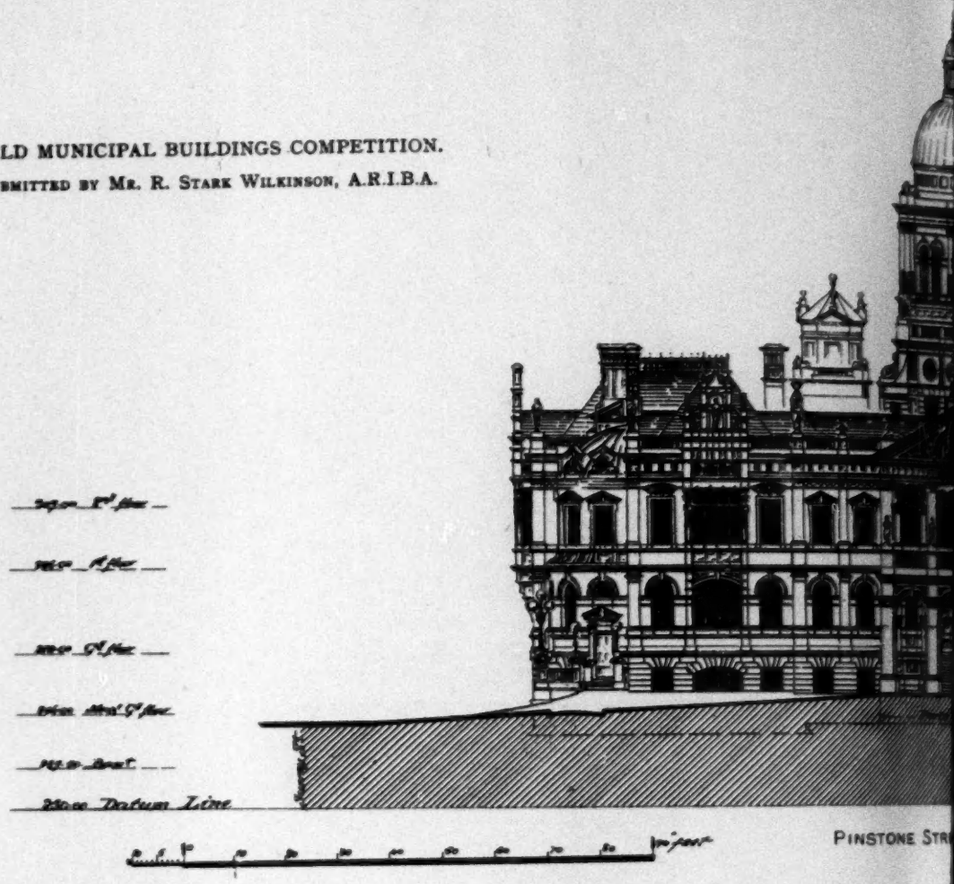
FIRST-FLOOR PLAN.

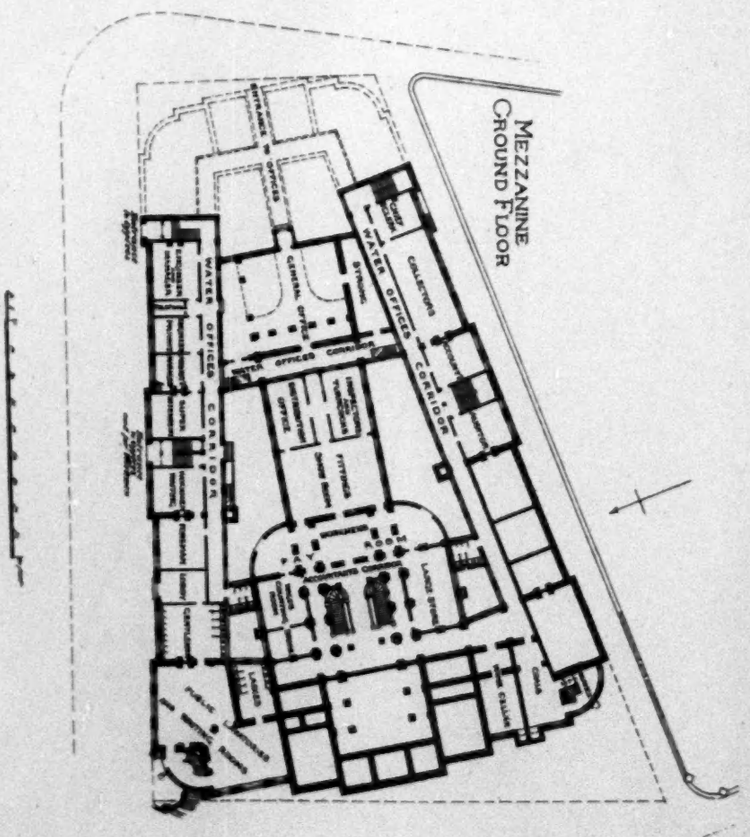
PHOTO LITHO. SPRAGUE & Co. 52, MARTINS LANE, CANNON ST. LONDON, E.C.

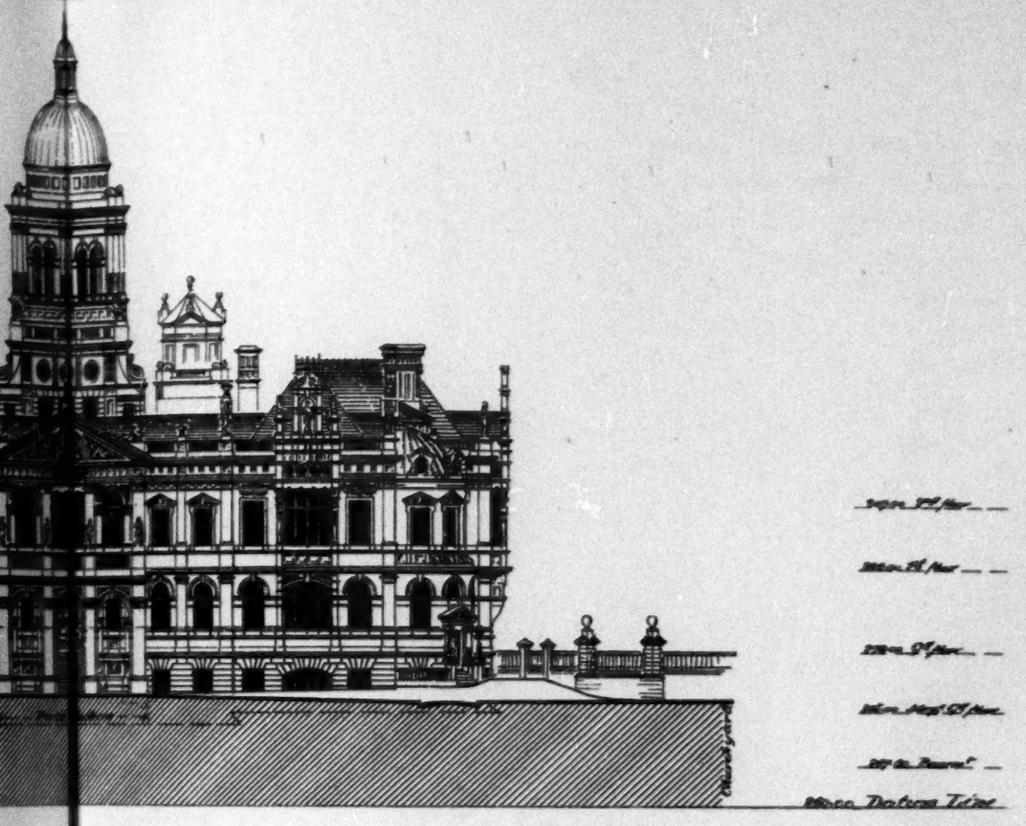
DESIGN SUBMITTED BY MR. R. A. BRIGGS, A.R.I.B.A.

SHEFFIELD MUNICIPAL BUILDINGS COMPETITION.

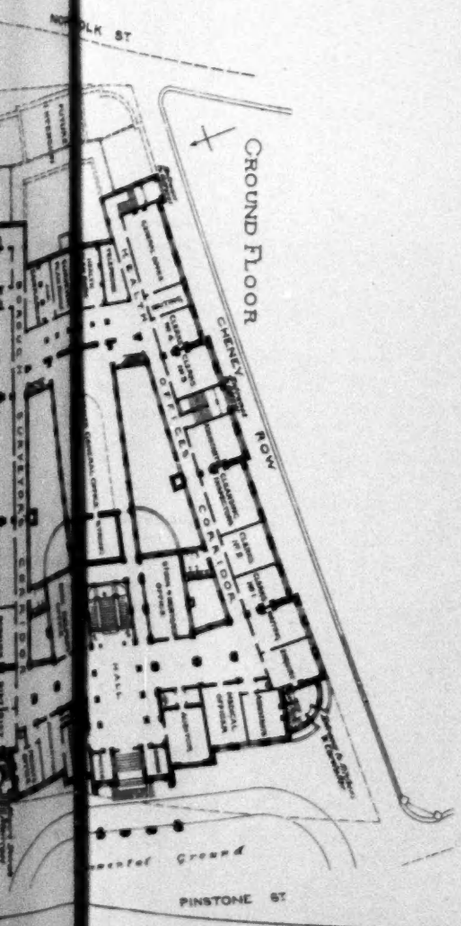
DESIGN SUBMITTED BY MR. R. STARK WILKINSON, A.R.I.B.A.







TONE STREET ELEVATION.



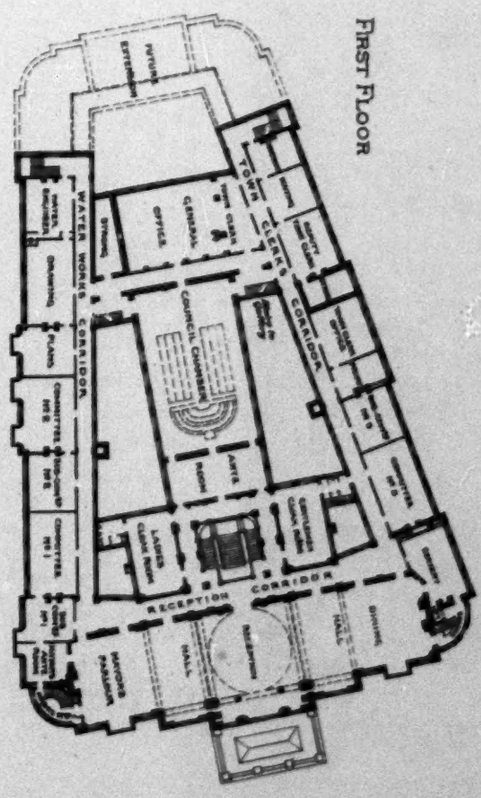


PHOTO LITHO. SPRAGUE & CO. 82, MARTINS LANE, CANNON ST. LONDON, E.C.

The warming and ventilation has been specially attended to in this design. Fireplaces have been placed in all the offices except the large general offices, which, together with all the corridors and all offices where fireplaces are not shown, will be heated by hot water, although open fireplaces could be introduced as features in dining-room and reception-hall if considered desirable.

It is proposed to provide inlet ventilators to all rooms and corridors heated by hot water, and there will be extract ventilating flues to all the large offices. The Mayor's apartments and the Council Chamber will have extract flues or shafts in roofs, and Boyle's extractors will be fitted to same. The small offices will have 9 in. by 6 in. inlet and outlet ventilators, and outlet ventilators will also be placed in all corridors, &c. It is proposed to light the whole of the building by the electric light, space for the apparatus being provided in the basement.

The building will be built of brick and faced with the best local stone."

The design next in order is that by Mr. W. Campbell Jones, who, like Mr. Briggs, makes his plan follow the lines of the site almost exactly. In his report he says:—

"In order that the best possible arrangement of plan giving facility of access to the various departments might be obtained, it has been considered desirable to cover the whole site with buildings, leaving, however, spacious courts for light and air between the blocks.

The portion of the building at the south-eastern side of the site is shown carried up to the level of the ground-floor ceiling only, and would be covered by a flat roof with a balustrade towards Cheney-row. Should, however, future extensions become desirable, this portion can be raised for one or two stories without any detriment to the appearance or comfort of the existing buildings.

The disposition of the rooms upon the various floors, as suggested by the Corporation, has been carried out with the following variations:—

Second Floor.—A portion of the Health Office has been placed here in preference to the first or ground floor, viz., the Cleansing Inspector's room and his assistant, and four rooms for clerks, as it was considered desirable that the second floor should extend the whole length of Surrey-street for architectural purposes.

First Floor.—Every room required on this floor has been provided, except the rooms mentioned above, but no rooms asked for on other floors have been put upon this floor.

Ground Floor.—Every room asked for on this floor has been provided, and, in addition to these, the strong room belonging to the Surveyor's department, the pay room and the wages counting room in the Borough Accountant's department, and two store rooms in the Engineer's department, all suggested in your particulars to be in the basement, have found a place upon this floor.

Basement or Lower Ground Floor.—Every room asked for has been provided here, except the above-mentioned ones, moved to ground floor.

The cubical contents of the building, calculated from the bottom of the footings, and including all towers, projections, &c., is 1,937,400 cubic ft.

The entrance to the Council Chamber for the public is from Surrey-street, and by the use of folding-doors is practically cut off from the rest of the building.

Over the Mayor's parlour on the first floor is shown a mezzanine gallery, which would be very useful for a band gallery or for the use of ladies, and would be an effective feature in the rooms.

The public lavatories on the lower ground floor have been carefully arranged to secure good ventilation, and a window is given to each w.c.

The warming to the offices of principal officials would be by open fireplaces; for the clerks' and larger offices a system of low-pressure hot-water pipes is suggested, circulating from the boiler-room at S.W. angle.

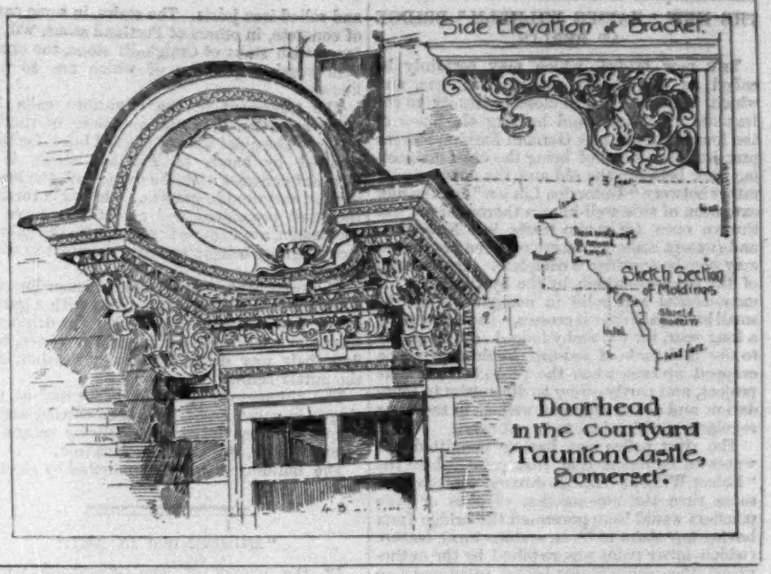
For ventilation of Council Chamber a special tube is provided, 4 ft. in diameter, and in the reception-rooms the foul air would be collected into the roof and got rid of generally over the building. Fresh air inlets would be provided about 5ft. 6 in. above the floor.

The principal offices would be provided with ventilating sun burners.

Materials: Exterior.—All walls visible from street to be faced with Ancaster stone from Messrs. Lindley's quarries,—a stone well qualified to withstand a smoky atmosphere. The base or plinth of the building towards the principal streets to be in Peterhead granite, but not polished. The interior courts to have facings of a hard white pressed brick, but dressings to be in stone. Roofs to be covered with best Westmoreland green slates. The front has been specially designed with a view to the judicious introduction of groups of sculpture and bas-reliefs, as roughly indicated upon the elevation.

The domes to be covered with copper and the figure on the summit to be in bronzed."

The next design, by Mr. John Robinson, makes some departure from the lines of the site, leaving out a corner next the church-yard in order to get a rectangular return to the principal front—a point not without importance where dignity of effect is desired.



As the author did not forward his report we must leave the design and plans to speak for themselves. The design is the one which we characterised as looking a little too much like a theatre; but it is an effective façade nevertheless. The author adopts the central position with top-light for the Council Chamber, a very good position for that purpose, but which involves the difficulty, not we think sufficiently recognised by Mr. Waterhouse in his address to students at the Institute recently (in which he went largely into the subject of this competition), of dealing with the space under such central room on the lower floor. The author has put the accountants' office there,—a central position, certainly, but somewhat too far within the building for convenient access for an office of this kind.

Mr. R. Stark Wilkinson's design shows, as we remarked at the time of the exhibition, a bold and original treatment of the plan by taking a centre line down the site and placing the plan symmetrically on either side of it. This makes a fine plan, but it has the defect of throwing away a good deal of ground on the front of the site, and throwing the Pinstone-street front back behind the line of the church-yard wall. The following particulars are given from the report:—

"A symmetrical arrangement of the site has been adopted by the author as most suitable for what is to be the dominant building in Sheffield, especially as by this a more extensive space is obtained in front of the principal façade; and the church is better brought into the perspective grouping with the new building, instead of being somewhat blocked out if the Pinstone-street line of frontage, shown on the block plan, were built up to, and also the front is now more parallel with Pinstone-street.

A continuous corridor is carried quite round the plan on each floor, giving access to all the offices from the Grand Staircase and from secondary staircases and entrances from Surrey-street, Norfolk-street, and Cheney-row, which are sufficient for official use when the Grand Staircase is required for receptions.

Large areas give sufficient light to the corridors and to the Council-chamber and central general offices, which are thus placed away from all noises arising from street traffic.

The general water-closets and lavatories are kept in isolated blocks, with good cross ventilation, in the same position on each floor; and all drains will have well-ventilated inspection manholes, to enable every portion to be reached for examination and cleansing purposes.

The Reception-rooms are conveniently approached from the Grand Staircase, with the Cloak-rooms adjacent to them and to the Council Chamber, the ante-room of which could be brought into use for reception purposes if needed. Movable divisions to be provided to keep the Dining-room and Mayor's Parlour distinct from the Reception-room.

The present proposed buildings finish with a good elevation towards Norfolk-street, and the spare space next this street can be built over in the future, as shown by dotted lines, in proper continuation of the main features of the design, and for the present can be laid out as a garden or court-space, with advantage to the Norfolk-street elevation.

The public waiting-rooms and lavatories for ladies and gentlemen are placed on the Mezzanine ground-floor level, at the corner of Pinstone and Surrey streets, as most convenient for 'bus and tram traffic, and have a distinct and spacious approach from the street level.

The plans now sent in competition are essentially sketches only, to be modified as to thickness of walls, spacing of windows and doors, and arrangement of pilaster columns and other ornamental features, both internally and externally, as may be necessary in the working out of further detailed plans and elevations.

All rooms not having open fireplaces to be warmed and ventilated under the general ventilation and heating scheme, the boilers being placed in a sub-basement in the centre block; but if more convenient they could be placed in a sub-basement at the Norfolk-street end.

The upcast-shafts are placed on either side of the large internal areas, and over the Council-chamber, the lobbies of the gallery stairs, and in the spaces adjoining the Reception-rooms and Grand Staircase.

The plan is generally compact, and the departments are kept together on five floors, to avoid a straggling plan, and to obtain a useful space for future extensions in Norfolk-street.

The fronts to be executed in stone of similar quality to the School Board Offices or the Yorkshire Penny Bank, with slate roofs and lead flats, gutters, and domes.

The elevations in the areas to be in stone and white glazed brick facings.

The floors generally to be of fire-proof construction, of coke breeze concrete and rolled iron joists, laid over with wood block, tile, mosaic, or cement flooring, as the case may require.

The staircases to be of stone, and the Grand Staircase of marble.

Heating and Ventilation.—Two main upcast-shafts are provided in a central position, for the extraction of the vitiated air, and to them the several offices, rooms, stairs, and corridors will be in communication by upcast-shafts provided from each of them. A special extraction-shaft is provided for the Council-chamber and also for the Mayor's Reception-rooms. The boilers are fixed in a central position, and it is proposed that the heating be by low-pressure steam, with the heating mains arranged in circuits for each department. Ventilating radiators will be used, so as to ensure in all seasons the renewal of the atmosphere of the spaces warmed and ventilated at least three or four times in the hour."

DOOR-HEAD, TAUNTON CASTLE.

THE door-head forms the entrance to a building of late date on the south side of the courtyard of Taunton Castle, and facing the great hall in which Jeffreys held the Bloody Assize. It is a fine example of its kind, the carving, although somewhat spoiled by repeated coats of paint, still retaining much of its original delicacy. The sides of the brackets are particularly good.

The Professorship of Building Construction and Architecture at King's College.—We are informed that Mr. Banister Fletcher, J.P., F.R.I.B.A., D.L., has been appointed to the Professorship of Building Construction and Architecture at King's College, London, in the place of Professor Kerr, F.R.I.B.A., who retires in July.

THE NEW "KAISER WILHELM" BRIDGE AT BERLIN.

THE new bridge, which may certainly be called an exceedingly monumental one, and which, besides being in close proximity to the Imperial "Schloss," and holding the name of the founder of the new German Empire, has the practical advantage of being the chief connecting link between the old and the new town, or rather between "Unter den Linden" and the new extension of this well-known thoroughfare, was thrown open for public traffic last November, and (except some sculpture over the keystones) may now be considered complete. The erection of the bridge,—which, by the bye, looks far too monumental and solid in comparison to the small breadth of river it crosses,—has taken many a long year, far too many indeed, owing partly to the multitude of red-tape hindrances which cropped up even when the project was a mere project, and partly owing to difficulties in foundation and construction as well as in the river regulations which had to be got over.

The river police not having permitted the water to be dammed at that point where the "Kaiser Wilhelm" Bridge crosses, whilst at the same time the non-erection of piers or even pilasters would have prevented the bridge from having any claim to be an architectural feature (which latter point was required by the authorities), the architect was bound to encroach on the embankments for the necessary room for the stream to pass through, and by doing this has been able to give the bridge three spans (one of 22·20 mètres, and two of 8·20 mètres), and two piers (of each 5·10 mètres), to a normal width of river of 38·50 mètres. Owing to the bridge not crossing at right angles, and owing to the fronts showing curvilinear lines, much time was spent in projecting the stereometrical forms of the different stones, and after this theoretical work had been completed, the very laborious practical part of cutting the material as required had to be gone through. This material,—which, by the way, was often very scarce, the quarries from which it came not having an over-abundant supply of good stones,—was of two kinds: black granite from the Odenwald, and grey granite from the Bavarian Hills, the former being used for the fronts and all architectural features, the latter for such parts as were not visible. As to the measurements of the erection itself, the wood-paved thoroughfare shows a width of 26 mètres, with two footways (paved with granite slabs) of 5·50 mètres each, 50 centimètres being given on the outer sides for the balusters. The surface of the wood-pavement of the roadway is 1·33 mètres over the intrados of the keystone of the central span, or 8·52 mètres over river bottom. The architecture of the bridge is of the sternest kind, four monumental candelabra (with eight electric arc-lights) of red granite with bronze mounting, and four tripods at the corners of the bridge giving the whole a finish, whilst the somewhat superfluous sculpture over the keystones, although effective in itself, stands in too great a contrast to the other parts of the design. Whatever faults the new bridge may have from the artistic point of view, the construction of the arches and the costliness of the material used will alone make the erection a remarkable one.

THE ARCHITECTURAL ASSOCIATION VISITS:

NEW HEADQUARTERS FOR THE POLICE.

THE large pile of buildings which will shortly accommodate the administrative department of the Metropolitan Police, now located at Scotland-yard, was visited on Saturday afternoon by a large party of members of the Architectural Association, who were received and conducted over the building by Mr. Norman Shaw, R.A., the architect.

The requirements of the department call for a large number of comparatively small rooms, and the convenient arrangement of these, with easy access for the public and between the different departments, formed the problem which has been successfully treated in the plan adopted by the architect.

The buildings entirely surround a square, open courtyard, and may be said to cover a square. Corridors run from end to end of each side of the square.

The interior fittings of the building will be simple and of a utilitarian character. Fireproof construction has been adopted in all the floors, with the usual combination of concrete and rolled iron joists. The stairs, in some cases of concrete, in others of Portland stone, will be faced with slabs of Craigleith stone, the excellent wearing qualities of which are so well known.

The treatment of the elevations calls for more attention than the simplicity of the interior. The quiet tone of the red brick facings, relieved by bands of Portland stone, is in pleasant contrast with the dulness of the lower portion executed in granite. The angle turrets, the most prominent and graceful features of the design, are in close contrast with the gables, lack of grace being singularly apparent in their treatment.

The treatment of the eaves is somewhat unusual, the deep cornice is provided with a gutter above, but it is doubtful whether the drippings from the eaves, some 4 ft. or 5 ft. above, will find their way direct, in stormy weather, into the gutter below.

The chimneys, which pierce the roof at the ridges in most cases, have been carried across frequently from the exterior walls by means of concrete flues, strengthened with iron.

The building will be illuminated by electric light.

"MODERNISM IN ART."

IN the course of the discussion which followed Mr. Henry Holiday's paper* at the last meeting of the Architectural Association,

The Chairman (Mr. Leonard Stokes, President), said it had not often been his good fortune to listen to such an admirable paper as Mr. Holiday had given them.

Mr. E. C. Robins, F.S.A., said he was quite sure they all agreed with the chairman's estimate of the lecture, which was a very interesting one, although he, the speaker, had hoped that it would have dealt a little more with art and a little less with political economy. But there was no questioning the fact that there was a close connexion between the two. Social questions were now coming to the fore, and, after all, it was nothing very unusual for men like Mr. Morris and Mr. Holiday to show broad sympathies with the well-being of the people; and as artists they of course believed in the elevating influences of art, and desired to witness its enjoyment by the people. Whether or not they thought Mr. Holiday's views were at all practicable, and whether the present generation would witness the realisation of a better state of things than now prevailed, they could not but admit that the ends aimed at, and the goal looked forward to by Mr. Holiday, were most desirable. In listening to Mr. Holiday's paper, he had been reminded of the pretty picture which Dr. Richardson had drawn some years ago of an ideal city of Hygeia. We had not yet seen that city of Hygeia constructed; indeed, in spite of much good work that had been done by sanitarians, there were parts of the country and many towns which were still in a very low sanitary condition. But he thought there was no ground for despondency as to the future of either sanitation or art, nor as to the amelioration of the lot of the poor. He had read the "Fabian Essays" which had been referred to, and he had also read in *Macmillan* a criticism upon them. It should be remembered that the wages of the working classes, according to no less an authority than Giffen, had increased by from 75 to 100 per cent. during the last fifty years. As far as money was concerned, the larger amount of it went into the pockets of the people, but they did not all make the best use of it. He quite admitted that it would be a desirable thing to give workmen a direct interest in the success of their employers, and he thought that where it had been attempted to effect that object under proper conditions the results had been satisfactory as in the case of M. Leclaire. He had been reading an account of M. Leclaire's experiment in industrial co-operation by Professor Sedley Taylor in the *Nineteenth Century*. M. Leclaire was a decorator who, although he treated his men well, found that they took no interest in preventing the waste of material. He conceived the idea of making his own interests identical with those of the men, and devised a system by which he shared his profits with his men. The scheme was very successful. When he died, not having any children he left his establishment to the chiefs of his business, which was still being carried on and the profits divided amongst the men. Another well-known instance of individual co-operation in France was that which was carried on under the auspices of M. Godin. That scheme was also very successful, so much so that it was on record that on one occasion when losses had been incurred the men came forward and volunteered to share the loss with their employer. On the other hand, one or two schemes of industrial co-operation which had been tried in this country had failed, notably in one case, that of a colliery. In this case, however, the experiment failed owing to breach of faith on the part of the colliery owners. Turning to the art side of the question, he admitted that it was very desirable that the people should acquire an increased love of art. But he could not admit that things were in so hopeless a condition as would be inferred from Mr. Holiday's remarks. Art, and especially the industrial art, of the present day, was not in its lowest stage. It was nothing nearly so bad as that of the time of the Georges. Ever since the 1851 Exhibition there had been a gradual rise in the level of art work. Good art could be produced now, but only, as in all ages, as the result of patient labour and long study. He had very great pleasure in moving a vote of thanks to Mr. Holiday for his interesting paper.

Mr. H. H. Stannus, in seconding the motion, said that, while thanking Mr. Holiday for his able paper, he certainly must express his agreement with Mr. Robins in the view he took that we certainly produced finer buildings and finer pictures than were produced in the time of the Georges, although the Academy pictures and our buildings of the better kind were not to be taken as criteria of the whole mass of the art and dwellings of the people. He thought that Mr. Holiday's remarks as to the reasons for our poverty in artistic ideas were very suggestive. He had very truly said that Giotto was modern in the best sense of the word, and that his art was the best art of his time. With regard to architecture, he would commend to the members a passage in Garbett's book, in which, speaking about richness in architecture, the author laid it down as a canon that richness was not one of the necessary elements of beauty in architecture: that there might be beauty without richness. He referred beauty rather to proportion and to the evidence of consideration for one's neighbours' buildings.

Mr. H. O. Cresswell, in supporting the vote of thanks, said that there was no doubt a great deal of force in what Mr. Holiday had said with regard to the pedantry of copyism, but nevertheless copyism had served to make us acquainted with the architecture of the past. We had certainly progressed very greatly since the time of the Georges, and he thought the outlook for the future was not altogether so gloomy as some might suppose.

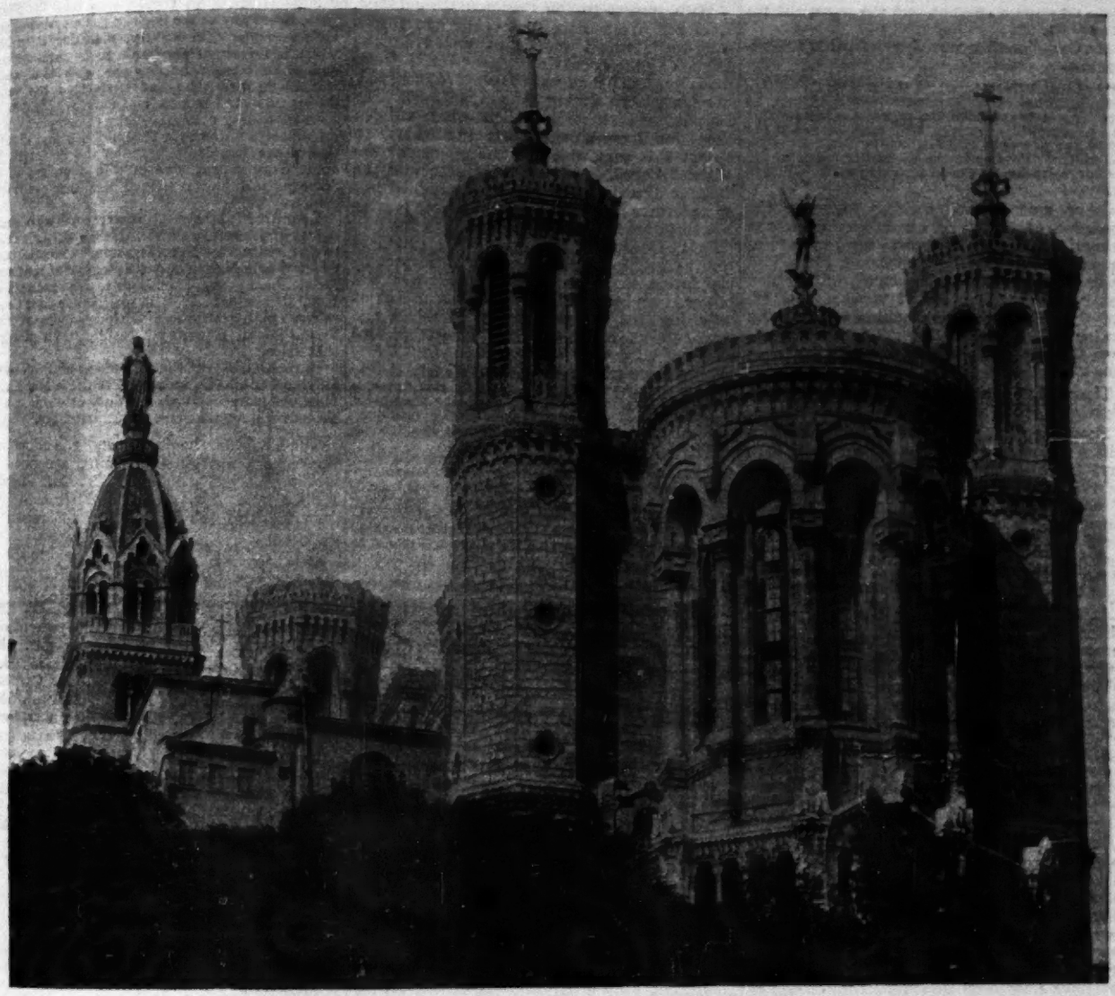
Mr. A. W. Earle having made a few remarks,

Mr. F. R. Farrow said he was not inclined to take so pessimistic a view of the art of the end of the nineteenth century as Mr. Holiday had taken. He thought that there were many evidences of a real awakening of interest in art. Even in the houses built by speculating builders there was a distinct effort after some kind of artistic embellishment. True enough, it was generally art of a very poor character, but the fact that it was supplied at all was evidence of the fact that the speculating builders recognised that there was a demand for something more than bare walls. As to the panacea which Mr. Edward Bellamy had put forth in his book, he did not think that any endeavour to exalt labour at the expense of capital would be successful.

The Chairman having made some observations, in the course of which he said that his sympathies were very largely with the views of the lecturer, the vote of thanks was put and carried; and Mr. Holiday having replied to some points raised in the course of the discussion, the meeting terminated.

* Printed *in extenso* in last week's *Builder*.

Ventilation.—Alterations are being made to St. John's Church, Carlisle, including the ventilation, Baird, Thompson, & Co.'s exhaust ventilator being adopted for the extraction of the vitiated air, and their air-inlet "panel ventilator" being used for the introduction of the fresh air. The firm have opened new showrooms at 165, Queen Victoria-street, E.C.



Notre Dame de Fourvière, Lyons. The late M. Bossan, Architect.

NOTRE DAME DE FOURVIÈRE, LYONS.

WE give an illustration of this modern French church, from a photograph, as the architect who designed it, the late M. Bossan, a native of Lyons, was held in great esteem among the profession in France, and in the course of a eulogy pronounced upon him at the time of his death, a few months since, this church was instanced as one of his most successful works.

The view unfortunately gives only a portion of the building, but sufficient to show its peculiar style, which to English eyes will probably seem odd and unsuitable enough, regarded as church architecture.

The church stands on a hill overlooking the Faubourg de Vaise, at Lyons, on the right bank of the Saône. There is a rope railway to ascend the hill, as well as various ordinary roads. This is said to have been the site of the ancient town of Lyons.

In 839 there still remained on the summit of the hill the ruins of a Roman Forum, which served for the construction of a little chapel of "Notre Dame du Bon Conseil"; but the name of its origin, "de Foro Vetere," has clung to the site up to the present day.

"Notre Dame de Fourvière" has been the object of pilgrimages for a thousand years back. After having been abandoned for some time in this sense, the shrine regained its popularity in the seventeenth century in consequence of a pestilence under which it was regarded as a place of refuge; and at the present time there are an immense number of devotees annually visiting the church for prayer and to suspend their votive offerings there.

The ancient chapel having been found insufficient, was replaced by the present one, begun in 1872 and completed in 1881.

The principal façade does not offer much of interest; but the apse with its flanking turrets is a striking and conspicuous object above the town. At the other end of the church is the main tower, the upper part of which is seen in the view, and which is terminated by a figure of the Virgin in bronze gilt, five and a half métres high, modelled by a Lyonnais artist, M. Fabisch.

THE LONDON COUNTY COUNCIL.

THE usual weekly meeting of the London County Council was held in the Council Chamber of the Corporation of London, Guildhall, on Tuesday last, Lord Rosebery in the chair.

The Architect's Department.—The Standing Committee's report contained the following paragraph:—

"We have received a report from the Architect, calling attention to the need, in his department, of an official to check accounts. This need has arisen in consequence of the resolution of the Council of December 3 requiring that in future the prices of articles supplied under contract shall be doubly checked, first by the department by which the orders are given, and afterwards by the Comptroller, and that the prices of articles not included in any contract shall be checked by the department giving the order. The Architect states that he has endeavoured to have the accounts checked in the manner prescribed by the Council, but that, as the practice is quite new, and he has no assistant who could be regularly employed upon the work, he has been unable to carry out the order satisfactorily. The result is that there are several accounts for work done during last year which have not yet been examined and put forward for payment. Having carefully considered the matter, we have arrived at the conclusion that if accounts for works and for articles supplied are in future to undergo a double check, a person possessing a knowledge of this kind of work should be appointed to examine bills, to whatever department they may relate, before they are certified by the head of the department having charge of the work, and passed on to the Comptroller. We recommend—

"That an official for the purpose above stated be appointed, that he be placed in the first class at a commencing salary of 200*l.* a year, and that it be referred back to us to take the necessary steps."

This recommendation was agreed to, after some discussion.

The Blackwall Tunnel.—The discussion of this question was then resumed, and occupied nearly the whole of the sitting.

The Vice-Chairman, Sir John Lubbock, by way of giving effect to the suggestion made by the Chairman when the subject was last under discussion by the Council, moved the following amendment to the report of the Bridges Committee:—

"That it be an instruction to the Bridges Committee to proceed provisionally with the tunnel at Blackwall under the Act of 1887, subject to the advice of an engineer of experience in subaqueous tunneling, and under such advice to sink shafts to ascertain the nature and difficulties of the soil, and then to report to the Council for further instructions."

Mr. Saunders, in seconding the amendment, spoke in favour of a tunnel extending only under the bed of the river, and with lifts in lieu of inclined approaches.

The amendment was opposed by Sir Thomas Farrer, Mr. Charles Harrison, and other prominent members, but was carried on a division by 57 votes to 48,—a majority of 9.

Sir John Lubbock's amendment having thus become the substantive motion, Mr. Corbett moved, and Mr. Beachcroft seconded, the following rider to it:—

"But that beyond the question of these provisional works the Council does not at present commit itself."

This was accepted by Sir John Lubbock and carried, after which, by 44 votes against 39, the Council approved the following further rider, moved by Lord Lingen:—

"And that the engineer conducting the experiments do report monthly to the Bridges Committee the nature

of the information obtained, and the progress of the expenditure."

Mr. Costelloe then moved, as a further amendment:—

"And that it be referred to the Bridges Committee and the Parliamentary Committee, acting jointly, to consider and report upon the expediency of obtaining an amending Bill, containing such modifications of the existing powers as to works as may be found desirable, and such provisions as to the method of providing for the future expense of the undertaking as may seem to be just."

Other amendments, seeking to make the execution of the work contingent upon the Council's obtaining powers to apply the principle of "betterment" to the property benefited by the construction of the tunnel, having been lost, it was resolved, by 47 votes against 42, that the following words should be added to the motion:—

"Provided the expenditure thereon shall not exceed 10,000*l*."

The resolution as amended was then formally approved.

Tramway Legislation.—The Highways Committee reported as follows:—"Your Committee have had before them a letter from Mr. T. H. Bolton, M.P., stating that he has given notice of a motion for the appointment of a Select Committee 'to inquire into the operation of the Tramways Act, 1870, and to consider as to the desirability of further legislation in the interest of the public with reference to tramways.' Mr. Bolton asks to be informed whether the Council is in favour of such an inquiry. Your Committee are of opinion that, having regard to the anomalous state of the existing legislation with regard to London tramways, an inquiry by a Select Committee of the House of Commons might be of advantage; and they therefore recommend—

'That Mr. Bolton be informed that the Council approves of the proposal for a Select Committee on tramway legislation, and will be prepared to give any assistance in its power to further the object of the inquiry.'"

This was agreed to.

Subways.—On this subject the Highways Committee reported as follows:—"The Council on the 19th of November last made by-laws under the Metropolitan Subways Act, 1868, and other Acts, for the regulation of the use of the subways in Garrick-street, Southwark-street, Victoria-embankment, Queen Victoria-street, and Commercial-road East. These by-laws have now been allowed by the Board of Trade, and the Home Secretary has signified his approval of the penalties specified therein. Section 202 of the Metropolis Management Act, 1855, provides that no by-law shall be of any force or effect until the same shall have been submitted to and confirmed at a subsequent meeting. Your committee therefore recommend—

'That the Council do confirm the by-laws made on November 19, 1889, for regulating the use of the subways in Garrick-street, Southwark-street, Victoria-embankment, Queen Victoria-street, and Commercial-road East.'"

This was also agreed to.

Disturnpiked Main Roads in the Metropolis.—On this subject the Highways Committee presented the following report:—

"The Council, on February 11 last, decided to offer to the respective Vestries and District Boards, in respect of the maintenance, during the year 1889-90, of the roads in their districts disturnpiked since December 31, 1870, and which by the Local Government Act became vested in the Council, equivalent sums to those paid by the Local Government Board in respect of such roads during each of the two preceding years. The sum thus offered in respect of Finchley and Edgware roads, which are in the parish of Hampstead, was 937*l*. 17s. 4d. With respect to this the Vestry has, by resolution, expressed the opinion that the proportion hitherto paid by the Local Government Board is inapplicable to present circumstances, especially as a large proportion of the wear and tear is due to through traffic, and has suggested that as the roads have during the year ended June 30, 1889, cost 4,736*l*., the Council should allow the Vestry at least half that amount. This expenditure was incurred during a year with only the last quarter of which the Council is concerned. Your Committee, having fully considered the matter, recommend—

'That the Council do adhere to the offer already made to pay the sum of 937*l*. 17s. 4d. towards the cost of maintenance of the Edgware and Finchley roads during the year 1889-90, and that the Vestry of Hampstead be so informed.'

With respect to the Commercial-road East, East and West India Dock-roads, and Horseferry-road, which were also vested in the Council by the Local Government Act, the offer made by the Council was to pay 487*l*. in respect of maintenance during the year 1889-90. The Limehouse District Board, in whose district these roads are situated, has decided not to accept this sum, which, in the opinion of the District Board, is quite inadequate; and the District Board has, moreover, determined not to undertake the maintenance of the roads after March 31 next. It appears to your Committee that the Council should in this case also adhere to the offer already made; and with respect to the future maintenance, should exercise the power given by the Local Government Act of requiring the District Board to retain the management of the roads. They therefore recommend—

'(*a*) That the Council do adhere to the offer already made to pay the sum of 487*l*. towards the cost of maintenance of Commercial-road East, East and West India Dock-roads and Horseferry-road, during the year 1889-90, and that the Limehouse District Board be so informed.

(*b*) That the Council, in the case of Commercial-road East, East and West India Dock-roads, and Horseferry-road (which roads have been disturnpiked since December 31, 1870) do exercise the rights conferred upon it by the Local Government Act, 1888, section 11 (sub-section 4), by requiring the Limehouse District Board to undertake the maintenance, &c., of the said roads, in consideration of such annual payment by the Council for the cost of the undertaking as may be determined in the manner provided by the said sub-section.'"

After some discussion these recommendations were agreed to.

After transacting other business the Council adjourned until Tuesday next.

THE ARCHITECTS' BENEVOLENT SOCIETY:

ANNUAL GENERAL MEETING.

THE fortieth annual general meeting of the Architects' Benevolent Society was held on Wednesday, the 12th inst., at 9, Conduit-street, Mr. J. Macvicar Anderson, Vice-President of the Royal Institute of British Architects, in the Chair. The minutes of the thirty-ninth annual general meeting having been read and signed as correct, the Hon. Secretary (Mr. W. H. White) read the Report of the Council, of which the following is an extract:—

"Gentlemen,—The *Red Book* published last year contained a brief summary of the reports for the years 1884–85 to 1887–88, in addition to a report of the past year's work, in order to preserve a continuity of the history of the society; and, consequently, the present report will deal only with the work of the society during the year 1889–90.

While being again able to congratulate the Society upon a considerable increase to its invested capital, your Council regret having to state that the subscriptions have decreased in amount; and they would urge upon each and every contributor the desirability of obtaining new subscribers. At the same time, your Council have pleasure in stating that the result of a special letter, in place of the usual circular, to several subscribers who were in arrear in January of this year, has been satisfactory; and as a similar appeal is being made to all subscribers whose subscriptions for 1889 have not yet been received, there is great probability that the increased amount of subscriptions obtained in 1890 will more than balance the decrease of the past year. The Income Account and Balance Sheet for the year ended December 31, 1889, are herewith submitted.

During the past twelve months six meetings have been held by your Council; £415 has been distributed among thirty persons out of forty-four applicants; and three pensions of £20 each have been paid. The amount received by subscriptions shows a decrease of about £28, being £308. 12s., as against £335. 18s. received in 1888. The Capital Account receipts amount to £557. 6s. 4d., including a donation of £500 from Mr. Robert P. Page, joint heir of the late Mr. Palgrave, who, it may be remembered by some, expressed his intention to leave £1,000 to this Society, but who died without signing the codicil to that effect. Upon coming of age Mr. Samuel P. Page made a donation of £500, and his brother, Mr. Robert Page, has now done the same—both acts of generosity worthy of emulation. Among others, donations were received from the British Architectural Book Society, per Mr. Cole A. Adams; the Northern Architectural Association; the Nottingham Architectural Society; Mr. John Cotton; Mr. A. S. Gover; Mr. C. H. Howell; Mr. George Inskipp, and Mr. R. St. A. Roumieu. The capital of the Society, which in 1883 consisted of Investments 6,174*l*. 17s. 8d., and Cash 100*l*. 2s. 6d., or a total of 6,275*l*. 0s. 2d., at the present time amounts to almost 8,000*l*., viz., Investments 7,871*l*. 2s. 4d., and Cash 53*l*. 18s. 8d., or a total of 7,925*l*. 1s.

Your Council regret to have to announce the decease of Mr. John Turner, who held the office of Hon. Secretary to the Society for a period of more than a quarter of a century, resigning it in 1875, when the Council tendered their cordial thanks and acknowledgment for the able and zealous manner in which he had performed the various duties entrusted to him, and also for 'the care and untiring energy evinced by him in carrying out the principles laid down for the guidance and distribution of the benefits afforded of the Society.' Mr. John Turner was one of the founders of the Society, and had remained a subscriber to the present year.

Your Council have also to record with similar regret the decease of Mr. George J. J. Mair, for twelve years the Hon. Treasurer, who was one of the first Life Members, and a Member of the Council for eighteen years. Mr. Mair resigned the office of Hon. Treasurer in 1885, in which year your Council referred with gratitude to the long services rendered by the genial Honorary Treasurer, then giving up that office.

In consequence of the retirement of Professor T. Hayter Lewis, who succeeded the late Mr. Mair as Hon. Treasurer in 1885, the duty of electing a new Treasurer devolves upon the contributors."

The Chairman having moved the adoption of the report, Mr. E. A. Gruning seconded the motion; after which Mr. T. M. Rickman, F.S.A., and Mr. John Hebb made some remarks, and the adoption of the report was agreed to.

A vote of thanks was then passed to the outgoing Members of Council, viz.:—Messrs. Arthur Cates, Edward A. Gruning, Herbert D. Appleton, C. Forster Hayward, F.S.A., and W. Hilton Nash; and the Council for the year of office 1890-91 was elected as follows:—Mr. Alfred Waterhouse, R.A., President; Messrs. G. P. Baggett, George Inskipp, R. H. Carpenter, F.S.A., E. Blakeway Fanson, M.A., J. Alfred Gotch, Samuel Hill, R. St. A. Roumieu, George Scamell, F.G.S., Lewis Solomon, Thomas Verity, William Emerson, H. L. Florence, Professor T. Hayter Lewis, F.S.A., Thomas M. Rickman, F.S.A., and Aston Webb. A vote of thanks having been passed to the auditors for the past year,—namely, Mr. Charles Fowler and Mr. T. M. Rickman, F.S.A.—Mr. W. Hilton Nash and Mr. John Hebb were elected auditors for the ensuing year of office. Mr. Arthur Cates was elected Hon. Treasurer, and the Hon. Secretary was re-elected.

ARCHITECTURAL SOCIETIES.

Sheffield Society of Architects and Surveyors.—The usual monthly meeting of this Society was held in the School of Art on the 21st inst., Mr. F. Fowler, President, in the chair, and a large number of members were present, including Messrs. C. J. Innocent, Vice-President, C. Hadfield, E. M. Gibbs, W. F. Hemsoll, J. B. Mitchell-Withers, Frank Massie, W. C. Fenton, J. B. Simpson, H. W. Lockwood, and many others. Mr. C. F. Wike, C.E., the Borough Surveyor, read an interesting paper entitled "Municipal and Sanitary Engineering." He presented statistics showing the relative sizes of Sheffield and other towns, and pointed out that Sheffield and Leeds had the largest areas of any English boroughs, each having an area of 20,000 acres. The next town in size was Bradford, with 10,776 acres. He also stated that Sheffield had an area equal to the areas of Manchester, Liverpool, Bristol, and Salford combined. He next dealt with the construction of roads, described the different kinds of granite, gritstone, and other materials used, gave particulars as to the manufacture of tar and concrete pavement, and as to the cost of maintenance. He also gave statistics as to the comparative cost of granite and gritstone paving, showing that at the end of twenty-five years the latter would have cost 50 per cent. more than the former. He then referred to the sections and gradients of roads, giving the formulæ of the most experienced engineers for cross sections. The second part of the paper dealt with sewerage and house drainage. The most modern methods of sewer construction were described, and particulars given as to the different forms of sewers, and the volume of sewage and amount of rainfall to be provided for. The question of sewer ventilation was also discussed, and various systems in work in other towns were described. Drawings were exhibited showing how engine chimney-shafts could be utilised for ventilating purposes, and the results of numerous experiments made with different sewer ventilators were given. The question of house drainage was then thoroughly gone into, and different methods of drain disconnexion and ventilation were ex-

plained. The use of rain-water pipes as sewer ventilators, and the use of soil-pipes as rain-water pipes, were condemned. The paper was illustrated with a large number of models, diagrams, &c., and excited considerable interest amongst the members of the Society, and an exhaustive discussion took place. A hearty vote of thanks to Mr. Wike was accorded on the motion of Mr. J. B. Mitchell-Withers, supported by Messrs. Frank Massie, C. Hadfield, W. C. Fenton, and H. W. Lockwood. The hon. secretary announced that next month Mr. T. M. Rickman, of London, would read a paper on "The Present State of Questions relating to Quantities."

Edinburgh Architectural Association.—At a meeting of this Association held in the Heriot-Watt College, on the 21st inst., Professor Baldwin Brown presiding, Principal Grant Ogilvie delivered a lecture on "Electric Lighting of Interiors." He began by explaining the terms used in describing electric currents, and showed the effect of the current on the conductor through which it passed, pointing out the application of the heating effect in the use of fusible "cut-outs," where a thin wire is used as part of the circuit, so as to cut off the current from a section where it might be becoming too strong for safety. He further explained the construction of incandescent lamps, and showed the high lighting efficiency now attained by some of these of 200-candle power and upwards. The arrangements for distributing the current to the various lamps in a house, the use of storage cells, and the distribution of electricity from central stations by "high-tension" alternating currents and transformers, were also discussed in the lecture. At the close Principal Ogilvie received a cordial vote of thanks.

PARTY-WALL CASES.

FOOT *v.* HODGSON.

In the City of London Court on Saturday last Mr. Commissioner Kerr gave judgment in the case of Foot *v.* Hodgson, which had been before him on three previous occasions and which involved a question of considerable importance to architects, builders, and building-owners. The action was brought by Mr. George E. Foot, of 16, Little Trinity-lane, E.C., against Mr. James Hodgson, of 19, Queenhithe, E.C., by way of an appeal against an award made by two out of three arbitrators, which directed that the party-wall between Nos. 16 and 17, Little Trinity-lane, E.C., should be pulled down and rebuilt in accordance with the provisions of the Metropolitan Building Act.

Mr. Fullerton was counsel for the appellant and Mr. A. H. Spokes for the respondent.

It seemed that in April last a fire occurred on the premises of the respondent, and now that the premises were cleared, it was urged on his behalf that the party-wall was so far defective and out of repair as to render it both necessary and desirable to pull it down and rebuild it. The matter was referred to arbitration, the arbitrators being Mr. T. M. Deacon for the respondent, and Mr. Stenning for the appellant, Professor Roger Smith being appointed third surveyor. In their award they ordered that the wall should be pulled down, but this decision was appealed against.

Mr. Stenning, Mr. H. H. Bridgman, Mr. Collins, and others said the wall was in sufficiently good repair as not to render it necessary to pull it down. On the other hand, Professor Roger Smith, Mr. Deacon, and others said the wall was not strong enough. They said that as there was a sloping roof they were justified in measuring the party-wall in such a way as to show that its breadth of two bricks was insufficient, and that it should consist of two and a half bricks.

Mr. Spokes said the mode of measurement was very important, as some District Surveyors in London were measuring one way, and others another.

Mr. Commissioner Kerr now gave judgment, and said the question had received the very careful attention not only of himself but of the assessors who had sat with him. He said it was represented to the Court that the building intended to be built was of the same height and in every respect similar to that which had been burned down; but it came out, however, in evidence at the end of the case that the building owner intended, if he could obtain the assent of the persons interested in preventing his raising the building, really to make his building a story higher by having what he called a vertical instead of a sloping side to the upper story; in other words, instead of laying his rafters on a wall of the same height as that which had been burned down, he intended, if possible, to raise that wall a story in height. It further appeared that an alteration was made in the building five years ago which had made the sloping roof to consist of two floors instead of one, and the result, it was contended, was to add a flat, if not a story, to the height of the building. Much contradictory evidence was adduced on the question of measurement, and there was great controversy as to what constituted a "story" within the meaning of the Act, the appellant contending that a story must mean a flat enclosed by four walls, the respondents urging that a story might be, and was, a story, although it might be what was ordinarily termed an attic or a flat in the roof. He (the learned Judge) agreed with the appellant, and considered that the roof began from the stonework on which the rafters of the roof rested; that all above the story enclosed by four walls was roof, and must, therefore, uphold the appeal.

Appeal allowed with costs.

MESSENGER *v.* LOADER.—GROOM *v.* LOADER.

These actions have been tried together in the Court of Chancery, before Mr. Justice Ford North.

The plaintiffs are respectively lessor and lessee of the "Highlander" beerhouse, High-road, Lee, and the defendant is a builder, who, after serving the usual party-wall notice, proceeded to build a separate external wall to his premises adjoining the party-wall.

The plaintiffs, for whom Mr. Cozens Hardy and Mr. Moyses appeared, claimed damages for trespass and for damage to the wall, calling the manager of the house, and Messrs. Pountney and Roberts, surveyors.

The defendant called Mr. Chas. Bell, F.R.I.B.A., and Mr. H. Lovegrove, F.S.I., to prove that the old wall was a party-wall, and that the alleged damage could be made good for a few pounds.

The Judge decided to dismiss the action by the freeholder (Messenger), each party to pay his own costs; and in the other action he awarded 25*l.* damages for the trespass, with costs on that part of the action only, as he dismissed that part relating to ancient lights.

CASE UNDER THE EMPLOYERS' LIABILITY ACT.

PUGH *v.* THE HORSLEY ENGINEERING CO., LIMITED.

In the Westminster County Court, on Monday, the case of Pugh *v.* The Horsley Engineering Company, Limited, was before his Honour Judge Bayley and a jury. The action was brought by the plaintiff to recover damages by way of compensation for personal injuries sustained owing to an alleged defect in the defendants' plant.

Mr. Moyses was counsel for the plaintiff, and Mr. Tatlock for the defendant company.

The plaintiff, Thomas Pugh, was called, and said he entered into the service of the defendants in November last year, at which time they had a large contract in hand for the construction of a railway at Liverpool-street. On the day of the accident, November 6, he was ordered by the foreman to assist a number of other workmen in moving a massive iron girder, weighing some 8 or 9 tons. The method adopted to move the girder was to get a bar of old railway line and lay under either end, and having well greased it, to slide the girder along. That operation proved very successful until the girder reached the end of the rails, when, owing to the upward projection of a bend, or what is technically known as a "burr," the girder refused to go any further, and it then became necessary to prise it up with crowbars in order to get it over the "burr." He (plaintiff) was ordered by the foreman to assist with others in bearing upon the crowbar, and the result was that when the girder was got over the obstacle it came down with very great force, and hurled the crowbar round in such a manner that it struck him violently in the chest, with the result that he was first thrown up into the air, and then precipitated into a cutting beneath, a distance of something like 15 or 20 ft. He remembered no more until he found himself in the hospital. There was no proper staging erected for the men to work upon, but only a few feet of platform composed of old sleepers laid side by side.

Cross-examined: He was compelled to obey the orders of the foreman, or he would have been discharged. He was acting under the instructions of the foreman when the accident happened.

A house-surgeon from the London Hospital was called, and gave evidence as to the nature of the injuries which the plaintiff had sustained. In his opinion the plaintiff would never again be fit to do laborious work.

That being the case for the plaintiff, Mr. Tatlock submitted that there was no case to go to the jury, as he contended that neither negligence nor defect had been proved against his clients, and therefore he was entitled to a non-suit. He did not propose to call any evidence.

His Honour said he did not think that the plaintiff had made out a case, but he (the Judge) thought he had better take the opinion of the jury on the matter.

Mr. Tatlock then addressed the jury at some length, and contended that the plaintiff was not entitled to recover any damages.

His Honour then summed up the evidence, and told the jury that if they were of opinion that there was negligence or defect, then they ought to give the plaintiff damages, but otherwise he was not entitled to anything.

The jury, after a brief consultation, gave a verdict for the plaintiff, and assessed the damages at £50.

Mr. Tatlock said that in spite of the finding of the jury, he should ask his Honour to enter judgment for the defendants.

His Honour said he should not adopt that course, but the defendants could have leave to appeal.

THE BRITISH COMMISSION AT THE PARIS EXHIBITION.

SIR,—As there is no wrong without a remedy, there must be a remedy for being slandered in *Truth*, but it is hard to find.

May I try and discover one by appealing to the fairness of the press in general to correct some mis-statements by one of their number, but which he has not had the generosity to withdraw?

It was stated in a paragraph in *Truth* that exhibitors at the Paris Exhibition were being dunned for a testimonial to the British Commission, and various comments were made on the fact.

May I ask you to state: 1. That no testimonial has ever been proposed to the Commission, Committee, or Council. 2. That I myself some months ago declined to accept any testimonial whatever, when on two several occasions the flattering suggestion was made. 3. That some of the exhibitors, acting entirely on their own initiative, are subscribing to make a gift to the members of the staff, who did the work and got none of the credit.

The question is one entirely without public interest, but it is hard, after trying to do one's work honestly, that one should be accused of petty meanness. I would not have troubled you had the editor of *Truth* published even the substance of the disclaimer I sent him, instead of absolutely distorting it. A copy of my letter to him is enclosed.

H. TRUEMAN WOOD,
Secretary, British Committee,
Paris Exhibition.

Society of Arts, John-street, Adelphi.
March 26.

PROVINCIAL NEWS.

Newcastle-on-Tyne.—A special meeting of the Newcastle Town-hall and Municipal Offices Committee was held on the 18th inst., under the presidency of Mr. W. Temple. Plans were presented by the City Engineer (Mr. Laws), showing the five sites retained, namely, No. 1, Singleton House; No. 2, Eldon-square; No. 3, ground between Clayton-street and *Journal* Office, including the Assembly-rooms; Nos. 4 and 5, two sites in Pilgrim-street, from Worswick-street to Manor Chare. Considerable discussion followed, and the two latter sites were struck out of the list as impracticable and unfavourable. It was then agreed that the City Engineer should prepare an estimate of the cost of the ground of each of the remaining sites, to be ready for presentation at the next meeting of the committee. Fresh plans were also presented by the City Engineer, showing amended arrangements for dealing with the present Town-hall and the conversion of the same into municipal offices, a concert-room, and an art gallery to be provided elsewhere in the city. This plan shows the whole ground-floor in the front portion of the building to be adequate for the purpose of the treasury department; the first-floor for the Town Clerk's department, and the upper floor for the City Engineer. An elaborate plan for converting the present concert room into a Council Chamber with a public gallery, Mayor's chamber, and other offices were also put in.—The Chairman stated that these alterations, if agreed to by the Council, would supply the wants and requirements of the city for the next fifty or hundred years.—A further scheme, combining the sale of a portion of the present Town Hall buildings, and leaving the concert room and Corn Market as at present, was also presented.—It was agreed that the entire schemes, when completed and put into order, should be submitted to the Council before any final decision was arrived at.

Sunderland.—On the 19th inst. a special meeting of the Sunderland Town Council, called by Alderman Fairless, Vice-Chairman of the Municipal Buildings Committee, was held in the Council Chamber of the new Town Hall, Fawcett-street, under the presidency of the Mayor (Councillor Shadforth). The Mayor congratulated the Council on meeting for the first time in the new Council Chamber.—Mr.

Brightwen Binyon, the architect, spoke in reply to the criticisms of Councillor Ranken at the last Council meeting. He had gone carefully into the figures, and he could not see how it was possible to make such a large reduction in the estimate as was proposed. £3,000 was inadequate to furnish the building.—The Mayor then suggested that the buildings should be furnished in such a manner as would not lead them to reflect afterwards on having furnished them inadequately.—Mr. Kirtley asked if Mr. Binyon was aware that £3,000 had first been put down for the furnishing of the building, and if he was also aware that such a sum would be totally inadequate, and that it was simply put down with a view of keeping the estimate within a sum which would pass the Council? Was Mr. Binyon aware of this, or a party to it?—Mr. Binyon replied that the estimate was made a long time before he was thought of.—Mr. Rickaby said that the general opinion of the Council at the last meeting was that the price put down for furnishing and decorating was too much. They desired to know if Mr. Binyon could see his way clear to having the building furnished for less, still maintaining the respectable character of the place.—In reply to Mr. Annison, Mr. Binyon said that the specification he had drawn up did not provide for the furnishing of the Town Hall in anything like the handsome manner some Town Halls in small Yorkshire towns were furnished. If the Council desired him to make another plan for furnishing he would do so.—The Council adjourned without coming to any decision beyond the general expression of a hope that economy would be effected wherever possible in the estimates.

The Student's Column.

ELECTRICITY, MAGNETISM, AND ELECTRICITY SUPPLY.—XIII.

DYNAMO-ELECTRIC MACHINES—(*Continued*).

RING ARMATURE.

THE greater the flux through the armature of a machine, by so much the greater will be its possible output. For this reason iron is used in the construction of armatures, which, by reducing the magnetic resistance, enables the magneto-motive force of the field magnets to send a larger number of lines of force through the coils than they would through air. Another function of the iron is to direct the lines where they are most needed, as well as to increase their number.

In the armature described in the last article the drum should be built up of thin discs, insulated from one another, as, were a solid iron drum used, current would be set up in it, for the same reason that current is set up in the parts of the coils which lie along its periphery. The iron should be continuous along lines of force and divided at right angles to them, as it is in this direction that the E.M.F. is set up; unless this is carefully done, currents are produced in the iron core, which not only absorb power uselessly, but produce heat to a dangerous degree. Even when laminated to the utmost extent practicable, the iron has still certain disadvantages; little local eddy currents, sometimes called Foucault currents, are formed in the solid portions, however thin, which require a small amount of power for their unavoidable production, and which cause a corresponding amount of mischievous heating. Again, as the iron revolves the magnetisation changes its direction, involving a constant movement of its molecules (see article II.) and since there is a certain amount of friction between the molecules, heat is also generated from this cause. Hysteresis is a word lately introduced to explain this and other phenomena observable in the magnetisation of iron.

Although it is difficult to separate the effects of Foucault currents and hysteresis, yet there is every reason to believe that, even if Foucault currents could be entirely eliminated, hysteresis would remain. In certain forms of armature, then, it becomes a question as to whether the advantages of reduced magnetic resistance are not more than counterbalanced by the introduction of the disadvantages just named, for although such substances as air or wood have a relatively high specific magnetic resistance, Foucault currents and hysteresis are absent from them.

A form of armature in which the iron is designed to direct the field as well as lower the magnetic resistance is the "ring armature," or "Gramme ring," shown in fig. 32. The iron core is entirely covered with bobbins connected in series. In the figure six skeleton bobbins are shown with their ends connected through the segments of the commutator.

In order to understand clearly the exact functions of the iron in the Gramme ring, suppose, in the first instance, that the ring itself in fig. 32 is made of wood or some non-magnetic substance, and that lines of force pass straight across the armature between the faces N and S of the field magnets. Remembering the diagram or rule for the direction of the E.M.F. set up in a conductor when it cuts a line of force, it will be seen that the directions of the electro-motive forces set up in the turns of the bobbins inside and outside the ring are such as to oppose each other. But all the lines between $N_1 S_1$ and $N_2 S_2$ are cut as many times in a complete revolution in passing through the interior of the ring as they are cut at the sides of the ring facing the field magnets; so that the whole field between $N_1 S_1$ and $N_2 S_2$ is absolutely useless, and the only parts of the field in which unbalanced E.M.F. is produced are those which lie, in the figure, above and below these lines. Assuming the field to be uniform, it is easy to measure, with a pair of dividers, what proportion of the total amount of the wire on the armature is of any use at one time.

In the case of the drum armature, no such opposing E.M.F. would be set up, as there are no interior parts to the turns of the bobbins; absence of iron in this case, therefore, would merely result in a lessening of the flux across the armature, not in making one part of a bobbin oppose the E.M.F. set up in it to that set up in another part.

Now, however, suppose the wooden core exchanged for a soft iron one. A line of force starting at N_2 will, on entering the iron, pass through the core, owing to its low magnetic resistance as compared to the air-path through the interior of the ring, and emerge opposite the point S_2, where it enters the other field face. It will be seen from this that the iron core diverts the lines, and screens the wire on the interior surface of the ring from them, so that the opposing E.M.F., which is set up without the iron, is not produced at all in this latter case. The connexions shown in fig. 33

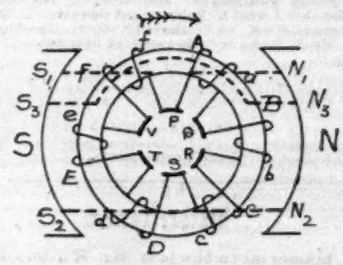


Fig 33.

are so extremely simple that it does not seem necessary to draw a supplementary diagram in order to show the action of the commutator, but a diagram to show its action may be drawn for fig. 33, just in the same way that fig. 32 was drawn to help the explanation of fig. 30. Figures 30 and 33 should, however, be compared. In fig. 33 electro-motive force is set up in the portions of the conductors on the outer surface of the ring, in precisely the same way that electro-motive force is set up at the surface of the drum. As the inner portions of the bobbins on the ring are screened from lines of force, they need not be considered from this point of view. In both figures P and S are the segments of the commutator between which there is the greatest difference of potential, and on them should press the brushes.

In both armatures the bobbins are always divided into two groups, those in each group being connected in series, and the two groups thus formed put abreast. As the brushes of a machine are fixed, and the segments of the commutator on which they press are in connexion with two points in the armature, they may be regarded as being fixed in space when the armature revolves, although they do in reality oscillate backwards and forwards through a small angle when the segments slip under the brushes. The brushes have the potentials of these points, and if there is an external circuit, current is always being drawn between these points. A line joining them is called the "diameter of commutation." With the brushes placed on P and S the diameter of commutation would be a vertical line passing through the axis of the armature. It does not follow that a line joining the points of contact of the brushes will be the diameter of commutation, for the commutator may be bodily shifted round the spindle of the machine, provided that the connexions are kept intact.

We have hitherto supposed the armatures to revolve, open-circuited, in a field produced either by permanent steel magnets or by separately-excited electro-magnets, and the diameter of commutation, chosen so as to get the greatest difference of potential between the brushes, has been a line at right angles to the direction of the field. It will be shown in the next article that, when the armature is producing the current for which it has been designed, this is not the best diameter of commutation, but that it has to be slightly shifted forward. The angle which a diameter of commutation makes with the direction of the field produced by the field magnets is called the "angle of lead" of the brushes.

RECENT PATENTS.

ABSTRACTS OF SPECIFICATIONS.

2,388, Chimney-pots. R. Fox.

To prevent smoky chimneys, according to this invention a pot is made with the body cylindrical and the lower portion square or oblong on plan, with a flange at bottom. Near the top of the body and to the outside of it there are soldered two pieces of metal, one in the form of a hollow truncated cone, and the other of a similar shape, but inverted. The two pieces of metal at the edge of their larger diameters are soldered together, and at their smaller ones they are soldered into the body of the pot. In the lower of these two cones holes are formed for the entry of air. Three cones are placed one above the other on the pot, the whole surmounted by a dwarf cylinder, in which also are holes protected by wind guards. The wind enters the holes in the lower cone, passes through the small spaces, and issues in a cylindrical stream into the body of the pot from the space left between the inner and outer cones.

5,748, Fixing Letters to Fascias. J. Willing.

This invention consists in applying holding devices to support the letters in such a way that the device is not visible in front of the letter.

5,790, Drain-pipe Joints. W. S. Emden.

The socket of the pipe which is the subject of this patent is made with an inwardly projecting lip at its mouth, the lip nearly fitting the outer periphery of the inserted pipe, or a collar is fitted for a similar purpose. To make the joint, a lateral hole is made through the wall of the socket on its upper side, and after the pipe is inserted and luted round the narrow mouth of the socket, liquid cement is poured through this hole to fill the annular space within the socket.

5,806, Casement Windows. G. Prince and J. Clough.

A pinion wheel is fixed on a stud plate fixed to the casement window. Two brackets are fixed on the window frame, and the worm on a rod. This rod works in the brackets by means of a wheel or handle, which, when it is turned, opens or shuts the window at any required distance.

915, Paint Cans. E. Norton.

In order to provide a paint can of cheap and simple construction, which may be securely closed without the use of solder after the can is filled, a seam is by this invention folded or formed upon the top of the can, so that an ordinary slip cover may fit snugly over the same.

19,288, Blower for Grates. C. Lake.

The blower is a sheet of metal fitting close above the open front of the grate above the bars, and adapted to make a practically air-tight contact to prevent access of air above the fire. It is simply fixed by resting on the top bar of the grate, the difference in atmospheric pressure keeping it firm in position.

NEW APPLICATIONS FOR PATENTS.

March 10.—3,763, H. Horsey, Glazing Windows, &c.—3,776, W. Ingram, Sash Fastener.

March 11.—3,793, S. Flavel, Cooking-ranges and Fire-grates.—3,798, E. Cammiss, Brick Moulds or Dies.

March 12.—3,882, T. Birtwistle and S. Barkley, Safety Hinge for Folding Ladders.—3,885, C. Whitfield, Open Fire-places.—3,887, W. Thompson, Ventilators.

March 13.—3,942, G. Smith and R. Cooper, Joining Head-pipes.—3,974, J. Hart, Kilns.—3,985, G. Moller, Kilns for bricks, tiles, &c.

March 14.—3,994, J. Anderson, Metering Machines.

March 15.—4,066, J. Tracy, Heating Buildings, &c.—4,069, H. Conway, Brick for building pur-

ners.—4,083, G. Lawrence and A. Ranyard, Coverings for Water-closet Seats.

PROVISIONAL SPECIFICATIONS ACCEPTED.

1,115, T. Haas, Locking Devices for Double or Folding-doors.—2,020, J. Hatch, Roof-glazing.—2,065, A. Hay, Automatic Appliance for Fireproof Doors.—2,259, M. Chapman, Double-action Lock.—2,721, W. Fryer, Portable Stove for removing old paint, &c.—2,806, A. Bowie, Window-fastenings.—2,862, J. Williamson, Hatches.—2,881, J. Offord, Set-Squares, T-Squares, &c.—3,197, J. Bott, Circular Saws.

COMPLETE SPECIFICATIONS ACCEPTED.

Open to Opposition for Two Months.

5,775, J. Denny, Facing Bricks, &c.—5,952, E. Allan, Construction of Dwellings for the Poor.—6,849, J. Middlehurst, Flushing Apparatus for w.c.'s, &c.—8,051, W. Scott, Cut Sponge, to be used in place of Flock for Wall-papers, Decoration, &c.—16,706, P. Bonner, White-lead.—19,634, W. Gray, Ventilators.—20,240, A. Linford and Others, Soot-fasteners.—479, A. Marshall, Sewer-inverts.—640, A. Watson & R. Hooper, Rastrick Fire-grates.—1,458, B. Marshall, Sash-balances and Locks.—1,839, F. Schmidt, Double Windows or Casements.

RECENT SALES OF PROPERTY:

ESTATE EXCHANGE REPORT.

MARCH 17.—By WEATHERALL & GREEN.

Westminster—9 to 16, Clarke's Cottages, and 32 and 33, Causton-st., u.t. 11 yrs., g.r. £27. 10s., including mortgage	£176
Commercial-rd.—38, Morgan-st., f., r. £46. 16s.	400

By ROBINSON & FISHER.

Hampstead-rd.—19, Mornington-crescent, u.t. 28 yrs., g.r. £8, r. £60	640
Wimbledon, Pepys-rd.—A plot of f. land	75
West Worple-rd—A plot of f. land	50

MARCH 18.—By A. RICHARDS.

Caterham, Croydon-rd.—The f. residence "Eccles-bourne"	430
Croydon—37 and 38, Elgin-rd., f.	800

By DRIVER & CO.

Kensington—L.g.r. of £45, u.t., 63 yrs., g.r. £4.	820
L.g.r. of £90, u.t. 63 yrs., g.r. £6	1,680
L.g.r. of £45, u.t. 63 yrs., g.r. £6	780

By DEBENHAM, TEWSON, & CO.

Holborn—22, Thavies-inn, f., r. £100 p.a.	2,310
Islington—327, 329, and 331, Essex-rd., u.t. 55 yrs., g.r. £34	1,885
Regent's-sq.—Nos. 34, 36, and 39, f., £170 p.a.	2,700
Pentonville—25 and 26, Percy-st., u.t. 42 yrs., g.r. £12, r. £117	1,050
Caledonian-rd.—45 and 46, Luard-st., u.t. 51 yrs., g.r. £12, r. £72	640
Islington—22, Hanover-st., u.t. 46 yrs., g.r. £6, r. £58	410
Canonbury—34 and 35, Compton-st., u.t. 55 yrs., no g.r., r. £91	895
34, Compton-st., u.t. 55 yrs., g.r. £7, r. £48	380
Caledonian-rd.—L.g.r. of £18, u.t. 54 yrs., g.r. £3 p.a.	280
Camden Town, South Villas—L.g.r. of £33, u.t. 72 yrs., no g.r.	670
Kilburn Pk.-rd.—L.g.r. of £71. 7s., u.t. 86 yrs., g.r. £18. 7s. p.a.	920
St. Pancras—Contractor's yard and stabling, area 14,617 ft., u.t. 30 yrs., g.r. £7, r. £273 p.a.	3,900
20, 21, and 22, Platt-st., u.t. 59 yrs., g.r. £36	1,300
Wimbledon Common—F. house and range of buildings, 1a. 0r. 7p.	3,500

MARCH 19.—By R. J. COLLIER.

Stratford—85 and 87, Abbey-lane, u.t. 78 yrs., g.r. £5, r. £31. 4s.	105
Wood Green, Dagmar-rd.—Three plots of f. land	110
Enfield, Churchbury-rd.—Two plots of f. land	52
Victoria Pk.—1 and 3, Wansbeck-rd., u.t. 75 yrs., g.r. £5. 10s.	325
5, Wansbeck-rd., u.t. 75 yrs., g.r. £2. 15s.	155

By WOODS & SNELLING.

Eltham, Ct.-rd.—The residence "Mayfield," u.t. 75 yrs., g.r. £30	1,460

By PERKINS & CESAR.

Tooley-st., Stoney-lane—F. house and stabling, r. £100	1,950

MARCH 20.—By H. J. BLISS & SONS.

Bethnal-green—42 and 44, Temple-st., u.t. 16 yrs., g.r. £11 5s.	105
108 and 110, Coventry-st., f., r. £27. 6s.	440
24, 26, and 28, Felix-st., u.t. 12 yrs., g.r. £10, r. £62. 8s.	145

By GOUGH & DOVE.

Camden-town—29 and 31, High-st., u.t. 40 yrs., g.r. £40 to 1910 and £60 to 1930, r. £220	2,120
Peckham—3, 4, and 6, Vivian-rd., u.t. 64 yrs., g.r. £13. 10s., r. £71 p.a.	505

By W. R. NORRIS.

Hall's-pond—34, Kingsbury-road, u.t. 91 yrs., g.r. £6, r. £32	320

By NEWDON & HARDING.

Green-lanes—"Kent Lodge" and "Pleasant Villa," u.t. 28 yrs., g.r. £7	735
Kingsland—12, 14, 24, and 26, Shap.-st., u.t. 14 yrs., g.r. £7. 6s., r. £115. 14s.	465
Stamford-hill—13, 15, and 16, St. Ann-ter., u.t. 84 yrs., g.r. £19. 10s.	310
Islington—2 and 4, Poultenay-st., u.t. 15 yrs., g.r. £10, r. £56	110
43, Ecclesbourne-rd., u.t. 50 yrs., g.r. £6, r. £34	300
90, Ecclesbourne-rd., u.t. 44 yrs., g.r. £8, r. £30	250
Kingsland—284, Kingsland-rd., u.t. 18 yrs., g.r. £10	170
8, De Beauvoir-sq., u.t. 22 yrs., g.r. £5, r. £36	185

BY ALDERTON & CO.

Clapham—Seven f.g.r. of £1 each, with reversion in 44 yrs	£2,210
F.g.r. of £30, with reversion in 34 yrs.	3,550
F.g.r. of £150, with reversion in 34 yrs.	7,000
F.g.r. of £24, with reversion in 34 yrs.	930
F.g.r. of £18, with reversion in 44 yrs.	1,965

MARCH 21.—By F. J. BISLEY.

Rotherhithe—30, Elgar-st., f., r. £22. 10s.	205
54, Derrick-st., f., r. £14. 0s.	95
31, 86, and 87, Adam-st., f., r. £52	600
Bermondsey—75, Camilla-rd., u.t. 48 yrs., g.r. £5, r. £31. 4s.	240
New Cross—56, Caselia-rd. East, u.t. 68 yrs., g.r. £4. 10s.	220

By TOPLIS & HARDING.

Commercial-rd., E.—38 and 40, Grove-st., u.t. 9 yrs., g.r. nil, r. £57. 4s.	75
3, 5, and 31, Batty-st., u.t. 12 yrs., g.r. £13. 10s., r. £104	225

By NIGHTINGALE, PHILLIPS, & PAGE.

Wimbledon, Spencer-hill—"Carisbrooke villa," f.	1,350

MARCH 25.—By DEBENHAM, TEWSON, & CO.

Covent Garden—43, Catherine-st., f.	2,500

[*Contractions used in these lists.*—F.g.r. for freehold ground-rent; l.g.r. for leasehold ground-rent; i.g.r. for improved ground-rent; g.r. for ground-rent; r. for rent; f. for freehold; c. for copyhold; l. for leasehold; e.r. for estimated rental; u.t. for unexpired term; p.a. for per annum; yrs. for years; st. for street; rd. for road; sq. for square; pl. for place; ter. for terrace; yd. for yard, &c.]

MEETINGS.

SATURDAY, MARCH 29.

Architectural Association.—Visit to the new Hospital for Women, Marylebone-road. Mr. J. M. Brydon, architect, 3 p.m.

Royal Institution.—The Right Hon. Lord Rayleigh, M.A., F.R.S., on "Electricity and Magnetism." VII. 3 p.m.

Edinburgh Architectural Association.—Visit to Preston Tower, Preston Cross, and Prestonpans Church.

MONDAY, MARCH 31.

Royal Institute of British Architects.—Two Special General Meetings for members only. 7.30 and 8 p.m.

Builders' Clerks' Benevolent Institution.—Twelfth Annual Dinner, Holborn Restaurant. 6.30 p.m.

TUESDAY, APRIL 1.

Institution of Civil Engineers.—Mr. J. Robinson on "The Barry Dock and Railways." 8 p.m.

Sanitary Institute (Lectures for Sanitary Inspectors).—Mr. A. Wynter Blyth on "Sanitary Laws and Regulations Governing the Metropolis." 8 p.m.

Glasgow Architectural Association.—Mr. G. Tudhope on "The Development of Wood Carving."

WEDNESDAY, APRIL 2.

Civil and Mechanical Engineers' Society.—Mr. W. Lant Carpenter, B.A., B.Sc., on "The General Doctrine of Oceanic Vertical Circulation." 7 p.m.

British Archæological Association.—1. The Rev. H. Cart on "A Visit to Ephesus and Smyrna." 2. Mr. E. Peacock, F.S.A., on "Gokewell Nunnery, Lincolnshire." 3. Mr. R. Peters on "Discoveries at Launceston Priory." 8 p.m.

FRIDAY, APRIL 4.

Sunderland Architectural Students' Association.—Mr. R. Cropton on "Foundations." 7.30 p.m.

SATURDAY, APRIL 5.

Association of Public Sanitary Inspectors.—Mr. F. T. Poulson on "Social Environments." 6 p.m.

Miscellanea.

Memorial to the late Mr. William Hay, Architect.—A bronze medallion portrait of the late Mr. William Hay, Edinburgh, the architect who designed and carried out the St. Giles' Cathedral restoration, is now being erected in the north porch of the Cathedral by a few friends, who commissioned Mr. John Rhind, sculptor, to execute the work. The portrait is artistically modelled and a good likeness, and is the original of the plaster cast on view in the sculpture room of the Royal Scottish Academy. The inscription is as follows:—"In memory of William Hay, architect, who designed and carried out the restoration of this church. Born 1818; died, 1888."—*Scotsman.*

The Guinness Trust.—Lord Cadogan has generously given a site in Chelsea to the Trustees of the Guinness Fund, and the *Standard* states that the Trustees have instructed Mr. M. E. Macartney, of Berkeley-square, to prepare plans for the erection of artisans' dwellings on the site. The same paper says that the Trustees have also acquired by purchase sites in Columbia-road, Bethnal-green, and Brandon-street, Walworth; and have instructed Mr. F. T. Pilkington, of Russell-square, and Messrs. Joseph & Smithem, of Finsbury-pavement, to prepare plans for buildings on these sites.

Bucharest.—The international competition for the offices of the Administration of Roumanian Railways has been decided, M. Gaston Trélat, of Paris, winning the first prize (3,000 fr.), whilst the second and third prizes fell to two Bucharest architects.

The Lock-out of Kentish Brickmakers.—According to the *Maidstone and Kentish Journal*, there is favourable news in regard to the Kentish bargemen's strike. The Board of Conciliation formed at last week's meeting of some of the leading residents of Sittingbourne, Faversham, and surrounding districts was successful. It was the unanimous opinion of the gentlemen assembled that a Board of this description should be formed, and the following gentlemen were appointed as members of this representative Committee:—Sittingbourne, Mr. R. L. Knight and Mr. A. Chittenden, C.A.; Faversham, the Mayor (Mr. H. R. Child) and Mr. F. Johnson, C.C.; Milton, Mr. T. E. Denson and Mr. S. Lavington Evans; Rainham, Mr. F. Locke, D.L., J.P., and Mr. J. Mansfield; and Mr. Teynham, Mr. Robert Lake, C.C., and Mr. J. F. Honeyball. It was arranged that a meeting of this committee should take place with six members of the Kent and Essex Brickmasters' Association and an equal number of representatives of the Bargemen's and Watermen's Protection Society, if these organisations should consent to take this course. The threefold conference takes place at Sittingbourne on Tuesday next, and if there is no objection to this arrangement great hopes are entertained of something tangible being done towards settling the dispute. Distress is being keenly felt already in several cases where large families have been deprived by the lock-out of their sole means of subsistence.

Early Printing.—At a meeting of the Cardiff Literary Society, on Tuesday evening last, a lecture was given on "Early Printing and Book Embellishments" by Mr. Edwin Seward, F.R.I.B.A. There was a good attendance of the members, who inspected with much interest a valuable collection of books and engravings, which the lecturer showed as illustrations. These included works by the greatest of the early printers, specimens of the typographic art of the Aldines, the Elzevirs, Plantin, John Day, &c., being exhibited. After a historic reference to the origin of printing, the varieties of the earlier-known types were described. "Black-letter" was shown by examples dating from 1470 and 1492; "Italic" by a rare copy of Boccaccio's "Decameron," printed at Florence by P. de Giunta in 1527, and other early examples issued in Naples, Paris, and elsewhere, the initials in which were left vacant for illuminating by hand. Wood engraving was described in reference to the works of Caxton, Albert Dürer, and Holbein, whose "Dance of Death" was produced as an illustration. The application of copper-plate to books was shown by a number of old Italian, Dutch, and German title-pages, &c., one from the Plantin press at Antwerp, designed by Rubens, being especially fine. Many book portraits of old English work, with the decorative frontispieces illustrating English poetry books of about eighty years ago, were also exhibited, the lecturer pointing out that the beauty of such examples often brought about the reprehensible practice of despoiling valuable old works for the sake of their plates.

The Carpenters' Company and Technical Education.—The Carpenters' Company, who have taken a very prominent position in educational matters connected with the building trade, will hold, in June next, their annual examination in carpentry and joinery, both practical and theoretical, and in connexion with the same they have a free library, containing all the best books on these subjects, &c. The seven lectures, just completed under the auspices of the company, have been attended by a total of 3,700 persons, or an average of more than 500 per lecture. Their Institute on their estate at Stratford has 800 members connected with it, and the swimming-bath, with warm baths attached, opened last July, were used by upwards of 16,000 persons up to the end of the year. We believe that no company is doing more real work in connexion with their Guild than the Carpenters, and we heartily wish them all the success which their efforts deserve.

Social.—Another of those pleasant gatherings which tend so much to promote good feeling between employer and employed was held on Saturday evening last at the Holborn Restaurant, the occasion being the annual dinner and smoking concert of the staff of the well-known builder and contractor, Mr. John T. Chappell, of Lupus-street, Pimlico. It was very numerously attended, the chair being taken by the head of the firm. A very pleasant evening was spent, as much of the excellent programme being got through as time would allow.

Lead and Lead-workers.—A lecture on "Lead and Lead-workers" was delivered in the Lecture Hall of the Philosophical Institution, Edinburgh, a few days ago, under the auspices of the National Registration of Plumbers District Council for East Scotland. There was a large attendance of members of the plumbing trade and the public. The lecturer, Mr. James Macdonald, R.P.C., said it was during the Middle Ages that lead first began to assume that important character with regard to architecture which it still maintained. There could be no doubt that leaden roofs were known as far back as the gardens of Nebuchadnezzar and the porches of the Latin basilica, but it was to the magnificent roofs of the French and English cathedrals that they must look for the best possible type of its architectural value and importance. After referring to the frequent mention of lead in Scripture, the lecturer stated that the first gravitation supply of water to the city of Edinburgh was by means of a leaden pipe which in 1681 was laid from the Comiston Springs to a reservoir on Castle Hill. He inveighed against the modern plumber for consigning everything in the shape of lead to the melting-pot, and expressed his opinion that it was not creditable to the Edinburgh National Museum that it contained so few and meagre specimens of old lead-work. He particularly urged that a scientific knowledge of the properties of lead was essential to plumbers to enable them to so manipulate it as to secure the greatest durability and the most satisfactory results generally. Scottish plumbers were to be found in all parts of the globe, and, generally speaking, they took a distinguished position; but they, and all other plumbers, must improve themselves by earnest study in order to keep themselves abreast of the exacting demands and varying conditions of modern house sanitation. In conclusion, he strongly advised his hearers to take advantage of the facilities offered by the Plumbers' Laboratory in connexion with the Heriot Watt College.

The English Iron Trade.—The English iron market continues quiet, and reports as to its tendency vary greatly. The process of buying pig-iron is still a slow one, consumers only purchasing for immediate requirements, and this of merchants, as makers are out of the market at present, owing to the great difference of prices quoted by second-hand holders and producers. Although the Glasgow warrant-market has been firmer, not much business has been done during the week. Scotch makers' iron is also quiet, and prices quoted are irregular. Middlesbrough iron has gone up from 1s. to 1s. 6d. per ton. Bessemer iron in the north-west is unchanged with makers, while hematite warrants are advancing. In other districts prices are still weak. The trade done in finished iron is small, and values have not recovered strength. The demand for steel is dull, and as orders are not coming forward very readily, prices are going down. There is no further decline in rails in the north-west, but no orders can be obtained for blooms, billets, and slabs at 5*l.* 5s. to 5*l.* 10s., which is quite 10s. a ton lower than last week. Plates are likewise falling away in price. Shipbuilders are not booking any new orders, and engineers also report themselves quieter.—*Iron.*

Selby New Town-hall — The *Leeds Mercury* reports that in a limited competition, plans submitted by Mr. H. Thorp, of Leeds, have been accepted by the Selby Local Board for a new Town-hall, to be erected on a corner site at the junction of Gowthorpe-street and New-lane. The building is intended to take the place of the existing inconvenient Local Board offices, which will be pulled down to make way for the new structure. The accommodation to be provided will comprise a large Board-room, committee-room, Clerk's and Surveyor's offices, and a fire-engine station. The building is designed in the Tudor-Gothic style. It will have gables to each street, mullioned windows, and an angle oriel, with a strep pitched roof. Externally it will be faced with brickwork of a deep red colour, contrast being obtained by the use of cream-coloured Ancaster stone for the door and window dressings, and other architectural features.

Assistant Surveyorships, Staffordshire County Council.—We are informed that the successful applicants for the five assistant surveyorships under this Council are Mr. J. Percy Gates, Worthing; Mr. J. Howarth, Liverpool; Mr. Alexr. Kinnison, Eassie, Forfarshire; Mr. Chas. S. Morris, Bury St. Edmunds; and Mr. James Wylie, Linlithgow.

Madagascar Timber.—Strenuous efforts are being made to introduce timber from Madagascar into the English market. Hitherto the "Great African island" has exported but little in this direction, and most of what has arrived, chiefly smuggled ebony, seems to command good prices. Until quite recently the Malagasy Government prohibited the export of timber from the island, but at length a concession was granted to an Englishman, and a company has been formed to work it. This, the "Madagascar Forests Company, Limited," entertained a large number of timber merchants and others at luncheon at the Cannon-street Hotel, on Thursday, the 20th inst., Mr. J. W. Shepherd (of Messrs. Seddon & Shepherd) in the chair, to inspect samples of the wood. Amongst those present who referred to the timber resources of the country were Mr. S. Procter (Consul for Madagascar) and Mr. T. Roe, M.P. The principal varieties exhibited were a kind of rosewood, yellow teak, mahogany, and a remarkable species of the last-mentioned called "natte." All were peculiar in being very heavy, and, at the same time, not difficult to work. Subsequently the party went to the docks and viewed the materials in bulk. Judging from inquiries already made by merchants, it seems tolerably certain that Madagascar wood will soon become a conspicuous feature in the timber trade.

PRICES CURRENT OF MATERIALS.

TIMBER.	£.	s.	d.	£.	s.	d.
Greenheart, B.G. ....ton	6	15	0	7	5	0
Teak, E.I. ....load	11	0	0	14	0	0
Sequoia, U.S. ....foot cube	0	2	3	0	3	0
Ash, Canada ....load	3	0	0	4	5	0
Birch ,, ...load	3	0	0	5	0	0
Elm ,, ...load	3	10	0	4	15	0
Fir, Dantsic, &c. ....load	2	0	0	3	10	0
Oak ,, ...load	2	10	0	4	10	0
,, Canada ....load	5	10	0	6	10	0
Pine, Canada red ....load	2	10	0	3	10	0
,, yellow ....load	2	0	0	5	5	0
Lath, Dantsic ....fathom	5	0	0	6	0	0
St. Petersburg ....fathom	5	0	0	7	10	0
Wainscot, Riga, &c. ....log	0	0	0	0	0	0
Deals, Finland, 2nd and 1st. std. 100	8	0	0	11	0	0
,, ,, 4th and 3rd	7	0	0	7	10	0

TIMBER *(continued)*.	£.	s.	d.	£.	s.	d.
Deals—Riga	7	0	0			
St. Petersburg, 1st yellow	10	0	0	8	10	0
,, 2nd ,, ...	8	0	0	14	0	0
,, white	6	10	0	10	0	0
Swedish	7	10	0	10	0	0
White Sea	8	0	0	15	10	0
Canada, Pine, 1st	15	0	0	26	0	0
,, ,, 2nd	10	10	0	17	0	0
,, ,, 3rd, &c.	7	0	0	10	0	0
,, Spruce, 1st	8	15	0	11	0	0
,, ,, 3rd and 2nd ..	6	15	0	8	10	0
New Brunswick, &c.	6	0	0	8	10	0
Battens, all kinds	6	0	0	16	0	0
Flooring Boards, sq., 1 in., prepared, First	0	11	0	0	14	0
Second	0	8	0	0	10	0
Other qualities	0	6	0	0	7	0
Cedar, Cuba ....foot	0	0	4	0	0	7
Honduras, &c.	0	0	4	0	0	4½
Mahogany, Cuba	0	0	4½	0	0	5½
St. Domingo, cargo average ..	0	0	4½	0	0	6½
Mexican, cargo average	0	0	4½	0	0	6½
Tobasco ,, ...	0	0	5½	0	0	6½
Honduras ,, ...	0	0	5½	0	0	6½
Box, Turkey ....ton	4	0	0	12	0	0
Rose, Rio	15	0	0	20	0	0
Bahia	14	0	0	14	0	0
Satin, St. Domingo ....foot	0	0	6	0	1	3
Porto Rico	0	0	10	0	1	5
Walnut, Italian	0	0	4½	0	0	7

METALS.	£.	s.	d.	£.	s.	d.
IRON—						
Bar, Welsh, in London ....ton	8	2	6	8	10	0
,, ,, at works in Wales	7	15	0	8	0	0
,, Staffordshire, in London..	8	10	0	9	10	0
COPPER—British, cake and ingot	53	0	0	53	10	0
Best selected	55	0	0	56	0	0
Sheets, strong	62	0	0	0	0	0
Chili, bars	48	10	0	0	0	0
YELLOW METAL....lb.	0	0	5½	0	0	6
LEAD—Pig, Spanish ....ton	12	12	6	0	0	0
English, com. brands	12	12	6	13	0	0
Sheet, English	14	10	0	0	0	0
Pipe	15	0	0	0	0	0
TIN—Straits	90	15	0	0	0	0
Australian	90	10	0	0	0	0
English Ingots	95	0	0	0	0	0

OILS.	£.	s.	d.	£.	s.	d.
Linseed ....ton	23	5	0	23	12	6
Cocoanut, Cochin	27	15	0	28	0	0
Cocoanut, Ceylon	25	5	0	0	0	0
Palm, Lagos	24	10	0	0	0	0
Rapeseed, English pale	32	10	0	0	0	0
,, brown	31	0	0	31	5	0
Cottonseed, refined	22	5	0	0	0	0
Tallow and Oleine	21	0	0	40	0	0
Lubricating, U.S.	5	10	0	6	10	0
,, refined	7	0	0	12	0	0
TAR—Stockholm....barrel	1	6	0	0	0	0
Archangel	0	17	3	0	0	0

COMPETITION, CONTRACTS, & PUBLIC APPOINTMENTS.

Epitome of Advertisements in this Number.

COMPETITION.

Nature of Work.	By whom Required.	Premium.	Designs to be delivered.	Page
Laying-out Cemetery	Crumpsall Local Board	20*l.* and 10*l.*	May 19th	ii.

CONTRACTS.

Nature of Work or Materials.	By whom Required.	Architect, Surveyor, or Engineer.	Tenders to be delivered.	Page
Iron Fencing, &c.	Beckenham Local Bd.	G. B. Carlton	Mar. 31st	ii.
Improvements to Road, &c.	do.	do.	do.	ii.
Paving Works	Brentford Local Board	J. H. Strachan	April 1st	xiii.
Brick Sewer	E. Barnet Valley L. B.	G. W. Brumell	do.	xiv.
Roadmaking Works	Ealing Local Board	C. Jones	April 3rd	ii.
Supply of Flints	West Sussex County Council	C. Adcock	do.	ii.
Works at Liverpool and Birmingham	Midland Ry. Co.	*Official*	do.	xiii.
Cleaning, &c., Works at Cheltenham, &c. ...	do.	do.	do.	xiii.
Broken Blue Guernsey Granite	St. Matthew (Bethnal Green) Vestry	F. W. Barratt	do.	xiv.
Broken Flints	Kingston-on-Thames Corporation	*Official*	do.	xiii.
Supplying and Fixing Waterpipes, Plymouth	Royal Agricultural Soc. of England	....	April 5th	ii.
Alteration and Repairs to Hackney College	Bethnal Green Guardns	A. & C. Harston	April 7th	ii.
Granite Pitching	Swansea Harb. Trustees	A. J. Schenk	April 8th	ii.
Well Sinking	Gainsborough L. B.	D. G. Macdonald	April 9th	ii.
Additional Workshop Accommodation	Hackney Union	W. Barnett	do.	xiii.
Alterations at Schools	Westminster Union	J. Waldram	April 11th	xiv.
New Fitting Department Buildings	Sheffield Gas Light Co.	F. W. Stevenson	April 14th	xiv.
Extension of Landing Stage	Worthing Pier Co. Lim.	Jas. Mansergh	do.	ii.
Outfall Sewers	West Ham Council	Lewis Angell	April 15th	xiii.
Works, Electric Testing Station	London County Council	*Official*	April 16th	xiii.
Alterations to Nuneaton Post-Office	Com. of H.M. Works ...	do.	do.	xiv.
Wood Block Paving	Bournemouth Commrs.	F. W. Lacey	do.	xiv.
Cast-iron Water Mains	Hastings R.S.A.	Jeffery & Skiller	do.	xiv.
Painting, &c., Works, S.E. Hospital	Metro. Asylums Board	Jarvis & Son	April 17th	xiii.
Telegraph Factory, Clerkenwell	Com. of H.M. Works ...	*Official*	do.	xiii.
Additions to General Post-Office East, E.C.	do.	do.	do.	xiii.
Mission Buildings, Kensal-road, W.	....	A. R. Pite & Son	Not stated.	xiii.

PUBLIC APPOINTMENTS.

Nature of Appointment.	By whom Advertised.	Salary.	Applications to be in.	Page
Road Foreman	Birmingham Twn Coun.	Not stated	April 2nd	xviii.
District Surveyor	Sheffield Corporation....	do.	April 5th	xviii.
Borough Engineer's Assistant	Salford Corporation ...	120*l.*	April 7th	xviii.

TENDERS.

*** Next week, communications for insertion under this heading must reach us *not later than* 12 *noon on* Saturday, as we go to press a day earlier than usual.

BEXHILL-ON-SEA.—For completion of the Marine Mansions Hotel. Mr. J. B. Wall, architect, Walbrook, E.C.:—

E. Soper	£3,138	4	8
H. L. Holloway	2,714	0	0
P. Jenkins	2,700	0	0
Eldridge & Cruttenden	2,682	0	0
J. King	2,479	0	0
J. W. Webb	2,389	16	0
J. G. Nicolls, Catford (accepted)	2,335	15	0

BIRVAL (Ayrshire).—For the erection of a house at Barval, Ayrshire, for Mr. A. Jamieson. Mr. T. H. Smith, architect, 17 and 18, Basinghall-street, E.C.:—

Anderson	£1,250	0	0

EALING.—For additions to St. Mary's Boys' School, Ealing W. Mr. Robert Willey, architect, 66, Ludgate-hill, E.C.:—

Grover, Ealing	£430	0	0
Down, Ealing	424	9	0
Jobbins, Ealing	410	0	0
Jones, Ealing	405	0	0
Sills, Ealing	399	15	0
Nye, Ealing (accepted)	398	10	0

FAREHAM (Hants).—For the erection of an engine-house, boiler-house, coal-store, chimney-shaft, cottage, and other works, at the Knowle Asylum Waterworks, for the Hampshire County Council. Mr. Edward T. Hildred, engineer, Southall. Quantities by Mr. John M. Gritten, 59, Chancery-lane:—

R. R. Facey, Taunton, Somerset	£1,970	0	0
J. Plummer, Fareham	1,655	0	0
W. H. Simonds, South-street, Reading	1,499	0	0
Jas. Crockerell, Milford-road, Landport, Hants	1,445	16	0
Claridge & Bloxham, Banbury, Oxon	1,369	0	0
M. Nell, 165, Turner's-road, Bow, E.	1,319	0	0
W. Franklin, Portsmouth, Southampton	1,290	0	0
Morgan, Isted, & Morgan, Newtown, Southampton	1,286	0	0
P. T. Hall, Bedford-road, Southsea*	1,202	0	0

* Accepted.

FAREHAM (Hants).—For supply, laying, or fixing 3-in. water mains and castings, sluice-valves, &c., wrought-iron service-pipes and fittings, erecting iron tank, supplying and erecting engine and pumps, building engine-room, and other works, at Stubbington House, Fareham, for Mr. Montague H. Foster. Mr. Edwd. P. Hildred, engineer, Southall, Middlesex:—

H. Clark, Fareham	£816	0	0
W. Learmouth, Emsworth-road, Portsmouth	768	6	6
The Water Fittings and Sanitary Engineering Co., Portsmouth	763	5	2
G. Holdaway, Gosport-road, Fareham	725	0	0
Jas. Crockerell, Milford-road, Landport	714	0	0
A. J. Gould, Fareham	680	0	0
Geo. G. Warby, Fareham	668	7	8
T. P. Hall, Bedford-road, Southsea	651	0	0
Wm. Jenkins & Son, 36, The Parade, Leamington Spa (accepted)	632	13	6

HASTINGS.—For alterations and additions at "The Hermitage," Silverhill Park, Hastings. Mr. Arthur Wells, architect, 25, Havelock-road, Hastings:—

Taylor Bros., Hastings	£859	0	0
Thos. Salter, St. Leonard's	859	0	0
Eldridge & Cruttenden, St. Leonard's	830	0	0

HIGH WYCOMBE (Bucks):—For new saw sheds and machinery shops, &c., for the High Wycombe Timber and Cabinet Manufacturing Company, Limited. Mr. Thos. Thurlow, architect, High Wycombe:—

				(B*.)		
Hunt, C. H.	£636	0	0	£476	0	0
Woodbridge, G. J.	613	0	0	423	0	0
Lacey, J.	599	3	6	349	0	0
Myrton, A. H.	588	0	0	400	0	0
Harris, H.	585	18	0	385	18	0
Flint and Maddeford.	579	0	0	479	0	0
Gibson, G. F.	572	12	0	392	12	0
Bond, J. (accepted)	547	10	0	335	15	0
Nash & Sons†	537	10	0	322	10	0

*B— Company supplying timber.
†Withdrawn.

HIGH WYCOMBE (Bucks).—For new business premises, 84 and 85, Easton-street. Mr. Thos. Thurlow, architect, High Wycombe:—

G. J. Woodbridge	£895	0	0
G. H. Gibson	833	0	0
C. H. Hunt	727	0	0
Flint & Maddeford	696	0	0
W. R. Loosley	677	17	0
Nash & Sons (accepted)	659	10	0

HIGH WYCOMBE (Bucks).—For new business premises and cottages, Oakmead, for Mr. G. Picton. Mr. Thos. Thurlow, architect, High Wycombe:—

J. Bond	£1,059	10	0
G. H. Gibson	1,028	14	4
C. H. Hunt	980	0	0
Nash & Sons	946	0	0
W. R. Loosley (accepted)	917	0	0

LEICESTER.—For alterations and additions to premises (allowing for old materials), Gallowtree-gate, Leicester, for the Northamptonshire Union Bank, Limited. Mr. A. T. Draper, architect, Leicester:—

Hutchinson & Son	£1,508	0	0
H. Black	1,474	0	0
C. Wright	1,425	0	0
J. O. Jewsbury	1,365	0	0
G. Hewitt	1,335	0	0
H. Bland (accepted)	1,280	0	0

LONDON.—For the enlargement of the Duncombe-road School, Upper Holloway, by 400 places, for the School Board for London. Mr. T. J. Bailey, architect:—

		If Brickwork is built in cement.
Killby & Gayford	£14,020	£14,150
J. Grover & Son	13,640	13,750
Peto Bros.	13,632	13,706
Dove Bros.	13,492	13,605
G. S. S. Williams & Son	13,400	13,590
W. Goodman	13,348	13,502
B. E. Nightingale	13,220	13,335
E. Lawrance & Sons	12,913	13,023 *

* Recommended by the Works Committee for acceptance.

LONDON.—For the enlargement of the West-square School by 400 places, for the School Board for London. Mr. T. J. Bailey, architect:—

		If brickwork is built in cement.
B. E. Nightingale	£9,426	£9,526
Dove Bros.	8,280	8,365
Patman & Fotheringham	8,191	8,271
Colls & Son	8,153	8,239
Peto Bros.	7,993	8,052
Stephens, Bastow & Co.	7,890	7,970
W. H. Lorden & Son	7,879	7,967
J. M. Macey & Sons	7,807	7,921
D. Charteris	7,538	7,638
Lathey Bros.	7,450	7,570*

*Recommended by the Works Committee for acceptance.

LONDON.—For the enlargement of the Gravel-lane School, Houndsditch, by 210 places, for the School Board for London. Mr. T. J. Bailey, architect:—

				If brickwork is built in cement.
Staines & Son	£2,044	0	0	£2,074 0 0
W. L. Kellaway	1,972	16	6	1,998 17 10
B. E. Nightingale	1,925	0	0	1,945 0 0
Killby & Gayford	1,920	0	0	1,965 0 0
Atherton & Latta	1,913	0	0	1,952 0 0
J. Greenwood & Son	1,889	0	0	1,913 0 0
Colls & Son	1,801	0	0	1,822 10 0
J. Marsland	1,757	0	0	1,777 0 0*

*Recommended by the Works Committee for acceptance.

LONDON.—For the enlargement of the Flora-gardens School, Hammersmith, by 200 places, for the School Board for London. Mr. T. J. Bailey, architect:—

				If brickwork is built in cement.
Peto Bros.	£1,459	0	0	.. —
E. Lawrance & Sons	1,345	0	0	.. —
Lathey Bros.	1,336	0	0	.. —
T. Boyce	1,315	0	0	.. £1,340
J. Marsland	1,188	0	0	.. —
Colls & Sons	1,180	0	0	.. 1,206*

* Recommended by the Works Committee for acceptance.

LONDON.—For the provision of a new class-room to accommodate fifty children at the Upton House Truant School, Homerton, for the School Board for London. Mr. T. J. Bailey, architect:—

Atherton & Latta	£348	0	0
C. Cox	337	0	0
J. Grover & Son	330	0	0
W. L. Kellaway*	297	10	0
Staines & Son	296	0	0

* Recommended by the Works Committee for acceptance.

LONDON.—For new premises, Long-lane, Bermondsey, for Messrs. Margetson, Welch, & Co. Mr. W. Newton Dunn, architect:—

Hall, Beddall, & Co.	£22,926	0	0
Rider & Son	22,778	0	0
Outhwaite	21,960	0	0
Morter	20,710	0	0
Williams	20,490	0	0
Ashby & Horner	20,410	0	0
Colls & Sons	20,200	0	0
Holliday & Greenwood	20,200	0	0
John Greenwood	20,080	0	0
Stimpson	20,000	0	0
Downs	19,662	0	0

LONDON.—For rebuilding Nos. 43, 44, 45, 46, and 47, Threadneedle-street, and Nos. 1, 2, 3, and 4, Crown-court, E.C. Mr. T. H. Smith, architect, 17 and 18, Basinghall-street, E.C.:—

W. Brass & Son	£19,577	0	0

LONDON.—For painting, &c., at Kennington Park, for the London County Council:—

Grooves	£474	0	0 !
Gillingham	343	0	0
Simmonds	315	0	0
Blandford	297	0	0
G. Barker	295	0	0
Akers	274	0	0
Read	248	15	0
Rhodes	245	10	0
Lapthorne	239	0	0
King Bros.	211	0	0
Arthur	190	0	0 !

LONDON.—For alterations to "The Old Red Cow," Long-lane, Smithfield, for Messrs. Fleck & Son. Mr. Wm. West, architect, 19, Craven-street, W.C.:—

G. Barker (accepted)	£165	0	0

LONDON.—For alterations at the "Bell Tavern," High-street, Shoreditch, for Messrs. Gower & Levy. Mr. J. G. Needham, architect, 11, Powerscroft-road, Lower Clapton, N.E.:—

A. Hood (accepted)	£225	0	0

LONDON.—For repairing, painting, and decorating at "Hetherset," Leigham Court-road, Streatham Hill, for Mr. B. Smith. Mr. T. Phillips Figgis, architect:—

John Greenwood (accepted)	£315	0	0

(No competition).

LONDON.—For building public free library at Notting Hill, for the Commissioners. Messrs. Figgis & Wilson, 5, Adelaide-place, London-bridge, architects. Quantities by Mr. R. C. Gleed:—

Jolliffe	£5,495	0	0
Simpson & Son	4,929	0	0
Toten & Sons	4,850	0	0
Patman & Fotheringham	4,829	0	0
Colls & Son	4,777	0	0
Lawrence & Sons	4,750	0	0
Scrivener & Co.	4,713	0	0
Godson & Sons	4,578	0	0
Sealey	4,460	0	0
Greenwood (accepted)	4,290	0	0
Hayden (withdrawn)	3,903	0	0

LONDON.—For new house and stabling, Ryecroft-road, Streatham Common, for Mr. Geo. Parton. Messrs. Notley & Riches, architects:—

Laurence & Son	£5,224	0	0
S. J. Scott	5,100	0	0
Mason	4,993	0	0
C. Cox	4,968	0	0
Candler	4,900	0	0
John Greenwood	4,777	0	0
J. & C. Bowyer	4,671	0	0
Coulsett	4,642	0	0

LONDON.—For erection of band-stand at Clapham common, for the London County Council:—

Parham	£1,280	0	0
Smith	1,150	0	0
Lapthorne	997	0	0
Macey	964	0	0
John Greenwood	889	0	0
J. Martin	857	0	0

LONDON.—For the erection of new studios, Oakley-street, Chelsea, for Mr. W. Douglas. Mr. Elton Hawkins, architect, 19, York-buildings, Adelphi, W.C. Quantities by Mr. C. G. Saunders, 5, Agar-street, Strand, W.C.:—

S. G. Bird	£4,096	0	0
T. L. Green	3,959	0	0
W. H. Smith	3,953	0	0
T. Gregory & Co.	3,867	0	0
W. Johnson	3,630	0	0

LONDON.—For rebuilding No. 69, Wood-street, E.C. Mr. T. H. Smith, architect, 17 and 18, Basinghall-street, E.C.:—

W. Brass & Son	£2,026	0	0

LONDON.—For the erection of a warehouse, &c., at rear of premises in Richmond-street, St. Luke's, for Mrs. Martha Emms. Mr. W. Smith, architect, 62, Chancery-lane:—

Wilkinson	£1,085	0	0
Langham	1,049	0	0
Larke & Son	1,044	0	0
Ward & Lamble	973	0	0
Stephens	948	0	0
Mattock Bros.	933	0	0
Dearing & Son	860	0	0
Baylis	776	0	0

LONDON.—For pulling down and re-erecting No. 32, Hanbury-street, Spitalfields, E., for Mr. C. A. Vignes. Mr. John Hudson, architect, 80, Leman-street, E.:—

	Zinc Roof.	Asphalte Roof.
F. W. Horey, Whitechapel	£1,029	£1,047
Eaton & Co., Whitechapel	997	1,022
T. Little, Whitechapel	997	..
S. W. Hawkins, Old Ford	873	904
R. G. Battley, Old Kent-road	844	859
Coulsell Bros., Bethnal Green	842	874
W. Gladding, Mile End*	696	711

* Accepted.

LONDON.—For the forming of a new party-wall and other alterations, to 14 and 15, Cockspur-street, S.W. Messrs. Glasier & Sons, surveyors:—

T. Rider & Son	£1,138	0	0
F. G. Davis	1,134	7	6

LONDON.—For pulling down and re-erecting Nos. 70, 72, and 74, Upper Mall, Hammersmith, for Mr. Wm. Mussared. Mr. Geo. Saunders, architect, 111, King-street, Hammersmith. No quantities:—

Blackburn	£698	0	0 !
Nye	675	0	0
Atkinson Bros.	654	0	0
H. G. Heywood	647	0	0
Beaven	625	0	0
Webb & Rossa	595	0	0 !

LONDON.—For alterations, repairs, &c., at 5, Buckingham-street, W., for Mrs. Fisher. Mr. John H. Martin, surveyor, 83, Albany-road, S.E.:—

Longland (accepted)	£370	0	0

LONDON.—For alterations and repairs to 200, Great Tichfield-street, for Mr. Briggs. Mr. John H. Martin, surveyor, 83, Albany-road, S.E.:—

Cordwell	£369	10	0
Longland	366	0	0
Phelps & Son	350	0	0
J. Derry (accepted)	337	0	0

LONDON.—For alterations to the "Royal Oak" public-house, Whitechapel-road, E., for Mr. Samuel D. Isaacs. Mr. Joseph G. Needham, architect, 11, Powerscroft-road, Lower Clapton, N.E.:—

J. & F. Bane	£344	10	0
Walker Bros.	327	0	0
G. Lusk	325	0	0
A. Hood	312	0	0
G. Barker	290	0	0
A. & F. Wilson (accepted)	243	0	0
Gasfittings.			
Ungar & Co. (accepted)	23	15	0

LONDON.—For new shop front and back addition at 65, High-street, Deptford, for Messrs. Bland & Phillips. Messrs. Searle & Hayes, architects. No quantities :—

Barber	£395 0 0
Barker	390 0 0
Worsley & Co.	357 0 0
John Greenwood	333 0 0
Schofield	326 0 0

LONDON.—For alteration and additions to No. 1, University-street, Tottenham Court-road, W.C., for Messrs. T. W. Thompson & Co. Messrs. Bray, Young, & Co., architects. Quantities supplied by Mr. A. Johnson :—

Hall, Beddall, & Co.	£890
Patman & Fotheringham	845
Scrivener & Co.	763
Scharien & Co. (accepted)	678

LONDON.—For alterations, &c., at the City Arms, Bloomfield-street, London Wall, E.C., for Messrs. Jones Bros. :—

R. H. Bax, Mountgrove-road, Highbury (accepted)	£110

No competition.

LONDON.—For additions and repairs to two houses, Hampstead-lane, N., for Mr. Wm. Piper. Mr. Edward J. Paine, architect, 11, Great James's-street, W.C. Quantities supplied:—

Stimpson & Co.	£466 0 0
Bailey	454 0 0
Southcott & Co.	433 0 0
Oliver & Richardson	415 0 0

MALLING (Kent).—For the erection of a new brewery, stabling, boundary wall, &c., for Mr. W. Mercer. Mr. Arthur Kinder, architect, Suffolk House, Laurence Pountney-hill, Cannon-street, London, E.C. Quantities by Mr. Alexander H. Kinder, 34, Clements-lane, E.C. :—

	Brewery.	Stabling.
Geo. Hodges, West Malling	£2,978 19 3	£670 19 11
W. H. Archer, Gravesend	2,657 0 0	618 0 0
H. Stiff, Dover	2,685 0 0	585 0 0
G. E. Wallis & Sons, Maidstone (accepted)	2,420 0 0	556 0 0

ROMFORD.—For erecting the new Church of St. Alban. Mr. J. Kennedy, architect, 31, Great James-street, Bloomsbury, W.C. No quantities supplied :—

Dupont, Colchester	£1,895 0 0
Booth, Romford	1,489 0 0
Hammond & Son, Romford	1,338 0 0
Watson, Ilford	1,312 10 0
Ivory, London	1,249 0 0
Downing & Dairs, Romford	1,210 10 5

ROMFORD.—For enlarging the Albert-road Schools, for the Romford School Board. Mr. John Hudson, architect, 80, Leman-street, E. Quantities supplied :—

D. Argent, Barking	£1,175 0 0
T. Bruty, Hornchurch	1,150 0 0
W. Watson, Ilford	1,137 0 0
W. Gladding, Mile End	1,038 0 0
Coulsell Bros., Bethnal Green	1,033 0 0
C. Barnes, Ilford	996 0 0
Hammond & Son, Romford*	917 0 0

* Accepted.

STRATFORD.—For the erection of shop and warehouse in Burford-road, Stratford, E., for Mr. Samuel Clapp. Mr. John Hudson, architect, 80, Leman-street, E. :—

W. B. Baney, Forest Gate	£785 0 0
A. Reed, Stratford	711 0 0
Norton & Son, Stratford (accepted)	706 0 0

WOBURN SANDS.—For building "Wavendon Towers," at Wavendon. Mr. Charles Granville Baker, architect, 5, Bloomsbury-square, London, W.C. :—

S. Foster	£4,805 0 0

[No competition.]

Lists of Tenders for works at Southwark, Mitcham, and Loughton, received without senders' names, are ineligible for insertion.

*** **Next week,** communications for insertion under this heading must reach us not *later than* 12 *noon on Wednesday*, as we go to press a day earlier than usual.

SUBSCRIBERS in LONDON and the SUBURBS, by prepaying at the Publishing Office, 19s. per annum (or 4s. 9d. per quarter), can ensure receiving "The Builder" by *Friday Morning's* post.

TO CORRESPONDENTS.

J. P. L. (the statement is practically an advertisement).—F. D.—A. H. (too late).—W. A. H. (we will inquire).—G. V. (we do not care for such items).—H. A. S. (no space this week).

All statements of facts, lists of tenders, &c. must be accompanied by the name and address of the sender, not necessarily for publication.

We are compelled to decline pointing out books and giving addresses.

NOTE.—The responsibility of signed articles, and papers read at public meetings, rests, of course, with the authors.

We cannot undertake to return rejected communications.

Letters or communications (beyond mere news-items) which have been duplicated for other journals, are NOT DESIRED.

All communications regarding literary and artistic matters should be addressed to THE EDITOR; all communications relating to advertisements and other exclusively business matters should be addressed to THE PUBLISHER, and not to the Editor

PUBLISHER'S NOTICES.

Registered Telegraphic Address, "THE BUILDER, LONDON."

GOOD FRIDAY.—THE BUILDER for the Week ending APRIL 5th, will be issued on THURSDAY, the 3rd. Advertisements for insertion in that issue must therefore reach the Office before THREE p.m. on WEDNESDAY, the 2nd. Alterations in Standing Advertisements, or ORDERS to DISCONTINUE the same, must be at the Office by TEN o'clock on TUESDAY Morning.

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SITUATIONS WANTED.

FOUR Lines (about thirty words) or under) ..... 2s. 6d.
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PREPAYMENT IS ABSOLUTELY NECESSARY.

*** Stamps must not be sent, but all small sums should be remitted by Cash in Registered Letter or by Money Order, payable at the Post-office, Covent-garden, W.C. to

DOUGLAS FOURDRINIER, Publisher,
Addressed to No. 46, Catherine-street, W.C.

Advertisements for the current week's issue must reach the Office before THREE o'clock p.m. on THURSDAY, but those intended for the front Page should be in by the same hour on WEDNESDAY.

SPECIAL.—ALTERATIONS IN STANDING ADVERTISEMENTS or ORDERS TO DISCONTINUE same must reach the Office before TEN o'clock on WEDNESDAY morning.

The Publisher cannot be responsible for DRAWINGS, TESTIMONIALS, &c. left at the Office in reply to Advertisements, and strongly recommends that of the latter COPIES ONLY should be sent

PERSONS Advertising in "THE BUILDER" may have *Replies addressed to the Office, 46, Catherine-street, Covent Garden, W.C. free of charge.* Letters will be forwarded if addressed envelopes are sent, together with sufficient stamps to cover the postage.

AN EDITION Printed on THIN PAPER, for FOREIGN and COLONIAL CIRCULATION, is issued every week.

Now ready.

READING CASES, { NINEPENCE EACH. By post (carefully packed), 1s.

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TERMS OF SUBSCRIPTION.

"THE BUILDER" is supplied DIRECT from the Office to residents in any part of the United Kingdom at the rate of 19s. per annum PREPAID. To all parts of Europe, America, Australia, and New Zealand, 26s. per annum. To India, China, Ceylon, &c., 30s. per annum. Remittances payable to DOUGLAS FOURDRINIER, Publisher, No. 46, Catherine-street, W.C.

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BOX GROUND. | COMBE DOWN.
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London Agent—Mr. E. A. WILLIAMS, 16, Craven-street, Strand, W.C. [ADVT.

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The attention of Architects is specially invited to the durability and beautiful colour of this material. Quarries well opened. Quick despatch guaranteed. Stonework delivered and fixed complete. Samples and estimates free. Address, The Ham Hill Stone Co., Norton, Stoke-under-Ham, Somerset. London Agent: Mr. E. A. Williams, 16, Craven-st., Strand, W.C. [ADVT.

Asphalte.—The Seyssel and Metallic Lave Asphalte Company (Mr. H. Glenn), Office, 41, Poultry, E.C.—The best and cheapest materials for damp courses, railway arches, warehouse floors, flat roofs, stables, cow-sheds, and mill-rooms, granaries, tun-rooms, and terraces. [ADVT.

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Particulars on Application. Chief Offices:—Fitzroy Works, EUSTON ROAD, LONDON, N.W.